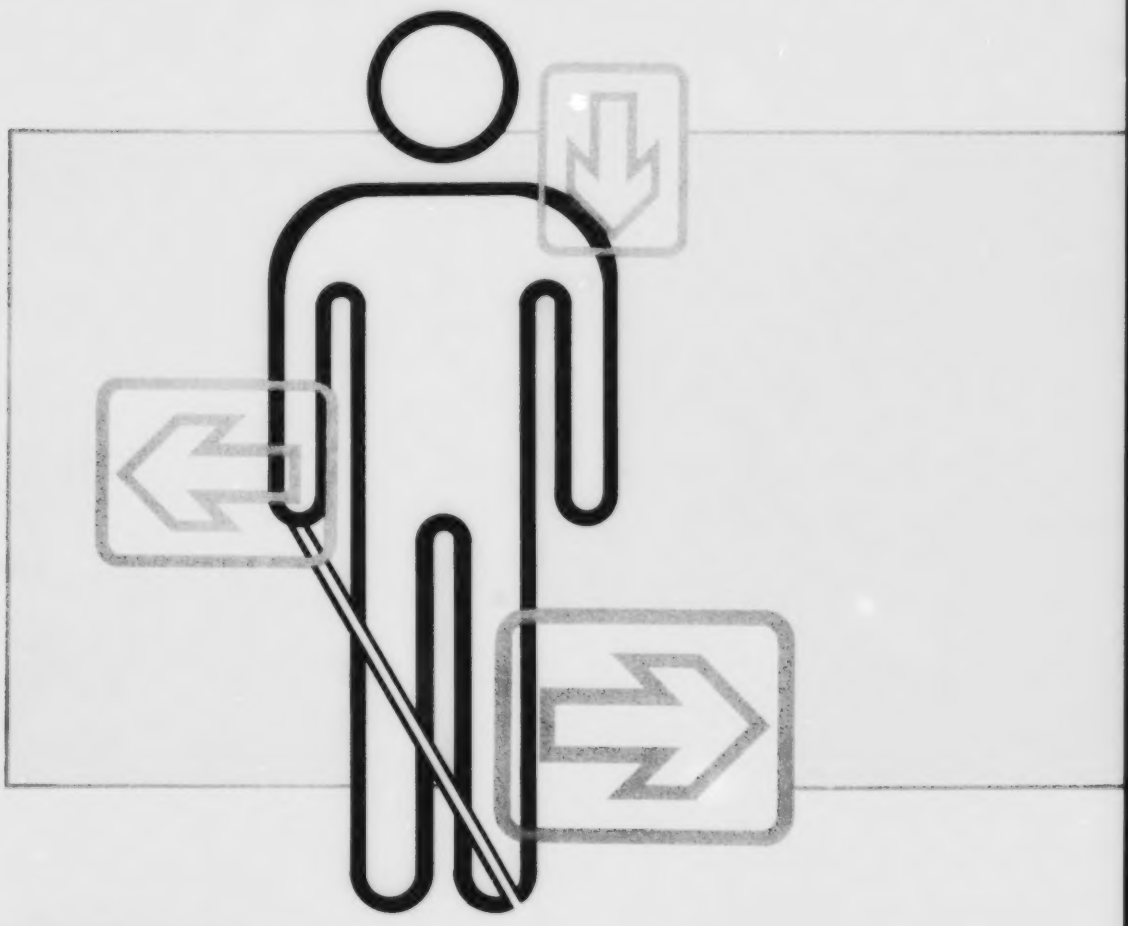
ACCESS NEEDS OF BLIND AND VISUALLY IMPAIRED TRAVELLERS IN TRANSPORTATION TERMINALS: A STUDY AND DESIGN GUIDELINES

Prepared for the Transportation Development Centre
of Transport Canada
by the Canadian National Institute for the Blind



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by

The Canadian National Institute for the Blind

December 1987

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17. Abstract

This report presents design recommendations and guidelines for meeting the access needs of blind and visually impaired travellers in transportation terminals. It describes how blind and visually impaired persons orient themselves and move through an environment. Legal blindness and various types of visual impairment are described; the effects of aging on vision are discussed; and demographics for the Canadian blind and visually impaired population are cited.

Orientation and mobility are defined vis-a-vis how blind and visually impaired persons travel. The use of mobility aids (guide dog, white cane, electronic devices, etc.) and of sensory information (visual, tactual and auditory) to effect safe and graceful travel through an environment is described and discussed.

Recommendations are made for specific research and demonstration projects necessary to improve access for blind and visually impaired travellers.

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17. Résumé

Ce rapport présente des lignes directrices et des recommandations pour l'adaptation des installations terminales de transport aux besoins des aveugles et autres handicapés visuels. Il décrit les méthodes utilisées par cette catégorie de voyageurs pour s'orienter et se déplacer, donne la définition légale de la cécité ainsi que les divers autres handicaps visuels. L'auteur aborde également l'effet du vieillissement sur la vision et présente les statistiques démographiques concernant la population aveugle ou visuellement handicapée du Canada.

Les mécanismes d'orientation et la mobilité des handicapés visuels sont définis dans le contexte des déplacements qu'ils doivent faire. L'auteur aborde également l'utilisation des aides à la mobilité (canne blanche, chien-guide, dispositifs électroniques, etc.) et les indices sensoriels (visuels, tactiles et auditifs) requis par les handicapés visuels pour leur permettre de se déplacer en toute sécurité et avec dignité dans les lieux publics.

Enfin, l'auteur propose des travaux de recherche et des expérimentations à entreprendre pour améliorer l'accessibilité des transports aux aveugles et autres handicapés visuels.

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SUMMARY

1. INTRODUCTION

The issue of accessibility by disabled persons to various transportation modes has received increasing attention in recent years. Much energy, funding and research have been directed toward removing architectural barriers for the individual who is mobility impaired. However, similar efforts for sensory-impaired Canadians have been slower in developing.

We estimate that there are at least 268,000 visually impaired persons in Canada. Of these, 20 percent are totally blind or are without the presence of some usable vision. Because aging and vision are related, the incidence of blindness and visual impairment will increase as the general population ages.

The research described in this report focuses on the access needs of blind and visually impaired travellers. For the purposes of this report, the term 'visually impaired' denotes those individuals who are totally blind and those who are low vision. The objectives of the work are as follows:

— To create a greater understanding of visual impairment and the effect of visual impairment on independent travel skills.

— To outline specific problems facing visually impaired travellers in the transportation terminal and to recommend solutions.

— To identify discrepancies in existing literature and standards concerning the access needs of visually impaired persons and to recommend areas of research and development necessary to resolve them.

— To develop a list of applicable technology, supplies and training techniques available to assist visually impaired persons.

The scope of the report is limited to transportation terminals, but practical application exists for the broader elements of the recommendations to improve access for visually impaired persons in all environments.

2. VISUAL IMPAIRMENT AND TRAVEL

To understand the impact loss of vision has on individual travel needs it is necessary to understand the heterogeneous nature of the visually impaired population. The abilities of visually impaired persons differ greatly: their amount of useful vision and how effectively they are able to utilize this vision varies; their level of orientation and mobility skills varies; they may choose different mobility devices to assist them in travelling; and their cognitive and psychological factors make each of them unique.

The planning of barrier-free environments for visually impaired persons is frequently ill conceived. Accessibility issues are considered from an architectural or structural perspective only. This approach addresses only part of the problem. For most visually impaired persons the real problems center around the following:

— A need for orientational and directional information upon approaching or leaving a terminal.

— A need for orientation assistance in the building design.

— Access to public information and communication systems.

— Operational procedures in a terminal.

— The expectations and attitudes of people.

3. CURRENT STANDARDS FOR ACCESSIBILITY

We reviewed accessibility standards which currently obtain in Canada. The report describes the building codes for each of the provinces with respect to accessibility as well as the content of other standards and guidelines used by designers to meet specific needs of mobility and visually impaired persons.

4. DESIGN RECOMMENDATIONS

General recommendations that must be considered to afford reasonable access to transportation terminals are presented under four headings: consultation team; orientation; mobility; and sensory information.

Consultation teams should be formed to assist designers by providing detailed, on-site analysis of the environment and specific input on ac-

cessibility for the site in question. They should be composed of building management personnel, design specialists, visually impaired consumers, and orientation and mobility specialists.

Orientation relates to the way visually impaired persons determine their position in an environment. A good building design is one that is easily understood by people with impaired vision. It focuses on distinctiveness and simplicity with sufficient accessible information regarding the environment. Various techniques are recommended to achieve the desired design: optimum use of colour brightness/contrast; careful use of illumination; well defined tactual cues; and, most importantly, consistency and uniformity.

Mobility is the ability to move gracefully through an environment and arrive safely at a travel objective. For the visually impaired person, part of safe movement in an unfamiliar environment is being able to safely maneuver around obstacles and travel hazards. An obstacle is an architectural or environmental obstruction in the path of travel that can be easily detected and negotiated by a visually impaired traveller using standard long cane techniques. While detectable obstacles can serve as landmarks for visually impaired travellers and can assist in orientation, they should be kept to a minimum.

A travel hazard is an architectural or environmental obstruction in the path of travel that cannot be readily detected and negotiated with standard long cane techniques. Examples of travel hazards include: some public telephones; stairs with open backs; curb ramps designed with only the wheelchair user in mind; and some store windows. Travel hazards should be eliminated from terminal design.

Sensory information includes visual, tactual and auditory information. A well designed environment provides the traveller with a rich, readily accessible array of sensory information. It does not present sensory deprivation or information overload. For example, designers should:

* Use only very high-quality visual information, e.g. make optimum use of colour/brightness contrast to enhance the environment, avoid visual noise, use proper illumination, eliminate glare, ensure good contrast between printed information and its background, use satisfactory proportions for letters and signs.

* Provide non-visual information to supplement and enhance the visual environment. Consider the use of sound, air movement, smell or tactile information for communicating with and directing travellers.

* Where possible, pair non-visual sensory information with visual information.

Flowing from these general recommendations are the specific design recommendations for more than 35 building elements, e.g., doors, windows, entrances, stairs, orientation aids, signage/symbols, furnishings.

5. CONCLUSIONS AND RECOMMENDATIONS

Access solutions for sensory-impaired persons almost always help the general public and especially the elderly. Better communications systems and better orientation strategies help everyone.

Research for this report uncovered dozens of international and Canadian studies on most of the areas covered by the report. We found that information held by one authority was not always shared with national service and consumer groups for blind and visually impaired persons or, indeed, with other researchers. It is recommended that every effort be made to ensure planners work in concert. Consistent solutions to terminal access problems applied across the country can offer more help to a traveller than the application of the most sophisticated technology at one location only.

A significant finding of the report notes that there are many, simple, inexpensive solutions to access problems. Their implementation requires mainly the application of simple techniques to make information available in a form more readily accessible to the visually impaired traveller. To do this efficiently in all transportation terminals requires that terminal designers be cognizant of the needs of these travellers and that the designers communicate with one another so that the various techniques used are used consistently in all terminals. An example of this type of solution is the lowering to eye level of one set of arrival/departure monitors at a consistent location in all terminals.

The technologies of detectable warning surfaces and talking signs are identified as areas where further research would be beneficial. There is a need to resolve several unknown factors surrounding the use of these technologies. To assist with this research and with the implementation of other recommendations and technology suggestions presented in the report, it is proposed that a model terminal be selected to serve as a demonstration project.

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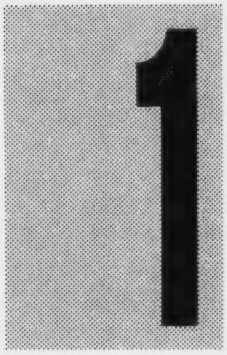
INTRODUCTION



1.1 BACKGROUND

The issue of accessibility by disabled persons to various transportation modes has received increasing attention in recent years. A fair amount of energy, funding, and research has been directed toward the environmental access needs of disabled Canadians. Much of this attention has been directed toward removing architectural barriers for the individual who is confined to a wheelchair, or who is otherwise mobility impaired. However similar efforts for sensory impaired Canadians have been lacking. There is a need to identify the environmental access needs of sensory impaired travellers so that they may access transportation terminals with the efficiency, convenience, and dignity comparable to that experienced by sighted travellers (1)*. Specifically, efforts must be made to assist visually impaired persons to travel independently, taking into consideration the effects of the environment on safe and efficient movement (2). Building designers are only beginning to recognize and acknowledge the needs of visually impaired persons.

The limited focus on access issues for visually impaired persons may be due, in part, to the fact that they are not normally denied access to transportation facilities because of architectural barriers. Rather they have accessibility difficulties due to the problems of orientation to new, and often large, transportation terminals. Visually impaired persons need to know where they are and how to reach a desired destination quickly and safely; or how to obtain needed information. The information necessary to resolve orientation problems is often lacking or inaccessible. Solutions to orientation problems are possible through: appropriate visual, auditory, tactile, and kinesthetic cues; speech, large print or braille technologies; and trained human resources. We require clear simple designs and direct, easy-to-access information systems to create an environment that meets the orientation and mobility needs of visually impaired persons. An environment thus created has the added benefit of also being a better environment for the general public.

Our review of existing literature relating to environmental access and visual impairment revealed substantial discrepancies in the research

* Numbers in brackets designate references listed at the end of the report.

and recommendations. Frequently, recommendations concerning access are based on input from practising professionals who have drawn upon their field experience and training. While these recommendations sometimes offer viable solutions, most of them are only suggestions and are not based upon objective research. Further research into the perceptual and communication needs of visually impaired persons is critically needed (3).

The Canadian transportation environment lacks consistent standards relating to visual impairment and environmental access issues. This lack has resulted in inconsistencies when modifications are implemented. With inadequate guidelines or standards, well meaning modifications have been implemented with mixed results. In some instances such modifications hinder rather than assist visually impaired persons and may even be hazardous to other travellers. It is necessary to establish appropriate standards governing access to the Canadian transportation system in order to ensure consistency in access design and the wise utilization of the funds available.

1.2 PURPOSE

The purpose of this program of research is to develop a reference manual to provide clear and concise information regarding the environmental access needs of visually impaired persons in federal transportation terminals (air, rail, ferry, and intercity bus). For the purposes of this manual, the term 'visually impaired' will denote those individuals who are totally blind as well as those who are low vision.

The specific objectives of this research program are as follows:

- To create a greater understanding of visual impairment and the effect of visual impairment on independent travel skills.
- To outline specific problems facing visually impaired travellers in the transportation terminal and to recommend solutions.
- To identify discrepancies in existing literature and standards concerning access needs of visually impaired persons and to recommend areas of research and development necessary to resolve the discrepancies.
- To develop a list of applicable technology, supplies and training techniques available to assist visually impaired persons.

1.3 SCOPE

The research for the development of this manual included: a review of relevant literature; professional consultation with researchers and specialists in transportation access and visual impairment; direct consumer input from visually impaired travellers; and the in-house expertise of the Canadian National Institute for the Blind (CNIB).

The scope of this manual is limited to transportation terminals; however, practical application exists for the broader elements of the recommendations to improve access for visually impaired persons in all environments. The recommendations in this manual can provide a framework for systematic standardization of access design for visually impaired persons.

The manual is partitioned as follows:

Chapter Two discusses vision, the many conditions that impair a person's vision, the effect of visual impairment on ease of movement, and the demographics of the visually impaired population in Canada.

Chapter Three describes how visually impaired persons interpret their environment when travelling from place to place.

Chapter Four identifies and evaluates existing accessibility standards relating to visually impaired travellers.

Chapter Five describes the needs of visually impaired travellers from their perspective. It synthesizes existing standards and the research conducted to develop this manual to provide general recommendations for the design and operation of transportation terminals for the greater benefit of visually impaired travellers.

Chapter Six presents specific design information meant to supplement existing accessibility standards with regard to access for visually impaired travellers.

Chapter Seven presents the recommendations and conclusions of the researchers with respect to the need for further research.

DEFINITION OF VISUAL IMPAIRMENT

2.1 LEGAL BLINDNESS

We estimate that less than 20 percent of the visually impaired population in Canada is totally blind or without the presence of some usable vision. A term often utilized to denote a certain level of clinical vision is 'legal blindness'. This phrase was coined primarily to determine the eligibility of visually impaired individuals for specific government programs and benefits. Legal blindness is defined as a visual acuity in both eyes with best corrective lenses of 20/200 or less and/or if the greatest diameter of the field of vision in both eyes is less than 20 degrees. In lay terms, a person with this amount of vision may be able to see at 20 feet or less what a person with normal vision can see at 200 feet. Those persons with a visual field of 20 degrees or less are said to have a field restriction and are 'legally blind' even though their visual acuity within that field may be normal. It is quite common for visually impaired persons to have an eye condition which may result in both a field restriction and an acuity loss.

The term 'congenitally blind' is used to describe those individuals who were born visually impaired or who lost their vision before the age of two years. These individuals accomplished their early learning and concept development without the assistance of full vision. They do not retain the same elements of visual memory as the individual who is 'adventitiously blind' i.e. one who lost vision later in life.

2.2 THE VISUAL SYSTEM

The visual system can be thought of as consisting of two distinct units: the 'what' system and the 'where' system. The 'what' system uses the center area of the visual field and is used to recognize, identify, and discriminate certain types of information in order to define things. The center area of vision is used to gain detail. The 'where' system uses peripheral or side vision and is used to detect or locate objects and detect motion and other changes in the environment. Peripheral vision is used to find objects and avoid obstacles. The two units work together, e.g. the 'where' system detects an object and then the individual will look directly at it so that the 'what' system can identify it (4). A visual impairment can affect the 'what' system, the 'where' system, or both.

The visually impaired population includes a wide range of visual functioning. Knowledge of a person's visual acuity or even specific eye condition does not guarantee an understanding of how that person is able to function using residual vision. For example some individuals with acuity difficulties may see best when they are very near an object or if the size of the object is increased: whereas other individuals with normal acuity but restricted fields may see best when they are actually farther away from the object and they can see all of the object within their limited visual field.

A small percentage of individuals who are legally blind have no usable vision; others are able to discern both the presence of light and the direction of the light source. While this amount of vision may seem minimal to the sighted population, many visually impaired individuals are able to utilize light perception and projection quite effectively to assist them in travel situations. For example they may sense light sources — such as a uniform row of overhead ceiling lights or windows along a wall — and use this information to navigate more efficiently in an unfamiliar environment.

Some individuals may be able to detect movement or the general shape of a large object but may not be able to see enough fine detail to visually identify the object. Still other individuals may be able to utilize print for information access, but only if the print is sufficiently large and other environmental factors — such as lighting and colour/brightness contrast — are optimal.

Individuals with field restrictions may possess what is commonly called tunnel vision; effectively, a very small area of clear vision in the center of the visual field. Depending on the severity of the field restriction, individuals with tunnel vision may have to systematically scan an object located close to them in order to see it in its entirety. Other field restrictions manifest as the reverse of tunnel vision. There is a central field restriction, that is a blind spot or scotoma in the center of the visual field. Persons with this impairment see best around the periphery of their visual field. Thus they will see an object most clearly when eccentrically viewing or looking off to the side of it. Still other individuals have eye conditions giving rise to a visual field with many scotomas scattered throughout the viewing area. In these cases, the 'islands' of remaining vision must be used to look around the scotomas.

In addition to the great differences in the extent of vision that individuals may possess, there can also be variations in the impairment to any individual over time. The nature of many eye conditions is such that while some individuals may experience stable levels of vision for

long periods of time, others may be experiencing frequent and erratic fluctuations of their visual level. The environment becomes that much more difficult to interpret if one's visual perception of it is constantly changing. Appendix A lists the various technologies, supplies and training techniques available to assist visually impaired persons.

2.3 AGING AND VISION

The three leading causes of visual impairment in Canada during 1986, ranked by frequency of occurrence, were: retinal disorders particularly macular degeneration, cataracts, and glaucoma (see Figure 1). Due to the aging process, these conditions are far more prevalent in the elderly population.

Macular degeneration

This condition is caused by a deterioration of the macular area, which is the area of best vision in the retina. An individual with macular degeneration may notice distortion, haziness, or the obstruction of the object of regard when looking straight at it. The person's peripheral vision generally remains intact.

Cataracts

This is a condition where the crystalline lens of the eye gradually becomes cloudy or opaque. This opacity, if positioned at a critical viewing location, can result in increased illumination/glare problems and greatly reduced visual acuity. It is estimated that 95 percent of cataracts can be successfully treated through modern surgical techniques.

Glaucoma

This condition is characterized by pressure within the eye causing damage to the optic nerve with subsequent problems in the visual field. These visual field problems usually result in a restriction of the peripheral vision resulting in tunnel vision. Depending on type and nature of glaucoma, there might be a slight or a tremendous restriction of vision (4).

(a)

A terminal as seen with normal vision

(b)

The same scene as might be viewed by someone with glaucoma who is experiencing a peripheral visual field restriction

(c)

The same scene as might be viewed by someone with macular degeneration who is experiencing a central visual field restriction

(d)

The same scene as might be viewed by someone with cataracts who is experiencing problems with glare and acuity

Figure 1 Examples of the effects of various eye conditions

Another major cause of visual impairment in the elderly person is diabetic retinopathy. This is an eye condition associated with diabetes mellitus where changes in the tiny blood vessels at the back of the eye cause hemorrhaging and excessive vascular growth. This condition may result in a blurring of the visual acuity, possible visual field distortions, and the presence of a reddish tinge which distorts colour perception. Diabetic retinopathy due to sporadic hemorrhaging often involves a great deal of visual fluctuation. There are two main types of diabetic retinopathy: proliferative and background. The latter type is not as severe and is more prevalent in the elderly population than the former type. Many individuals with proliferative diabetic retinopathy are treated with laser therapy to reduce excessive vascular growth. This laser treatment may cause an individual to experience peripheral field problems in dim illumination due to laser burns in the periphery of the visual field.

Even if vision is neither reduced to the level of legal blindness nor affected by specific pathologies, there are common visual changes associated with aging, particularly changes in the ocular lens. Researchers estimate that up to 95 percent of persons over 65 years of age experience changes in their ocular lens that result in less light entering the eye, more problems with glare, and distortion of colour perception. The lens of the eye tends to yellow with age thus reducing the light coming into the eye. The yellowing also alters color perception, particularly in the bluish end of the spectrum because yellow filters out blue. People require more light to function in the environment as their lens ages and they are better able to see colours at the red-yellow end of the spectrum. Because the fibres that make up the lens thicken with age, the lens loses its flexibility, hence accommodation — the ability to focus as objects come close to the eye — diminishes. Further, muscular changes in the iris also retard the light adaptation process of the eye, hence older people can be slower to adapt to bright light or to the dimmer light of a darkened room (4).

There is a marked decrease in the sensitivity of the peripheral fields after the age of 60. In addition a variety of perceptual changes occur: increased visual ambiguity, the maintenance of figural after-effects, diminished depth perception, decreased visual memory, diminished ability to establish closure, etc. These changes appear to be related to normal degeneration of both central and peripheral mechanisms of the eye and are compounded by pathology. The end result is information loss and increased misinformation about the environment (5)(6).

2.4 MULTIPLE DISABILITIES

The presence of an additional disability, such as hearing loss, can compound the travel difficulties associated with visual impairment. Deaf-blind persons, those who have some loss of both sight and hearing, are deprived of the two primary senses used to acquire knowledge of the world at large.

The term 'deaf-blind' does not necessarily mean total lack of hearing and vision. Individuals may have enough hearing to understand speech, especially when using a hearing aid, and may have some usable vision with or without corrective lenses. There is a difference between being born deaf-blind (congenital) and becoming deaf-blind later in life (adventitious). Those who are born deaf-blind need special education and individual attention early in life to stimulate their awareness of, and interest in, the external world.

The quality of language among people who become deaf-blind later in life is generally good. Individuals who retain their hearing long enough to learn to speak can continue to express themselves through speech after becoming deaf-blind; although they must learn a new mode of receiving language. (7) Deaf-blind persons may communicate by one of the following methods: sign language; one-hand, manual alphabet (finger spelling); or British, two-hand, manual alphabet. (See Appendix B.) The mode in which deaf-blind people express themselves depends on the amount of residual vision, knowledge of sign language, and whether or not they were deaf people familiar with sign language prior to visual loss. Most deaf-blind persons can utilize print-in-palm or written large print to communicate with persons who are not familiar with more advanced communication methods.

One of the keys to independence for a deaf-blind person is intervention. This important service is provided by an intervenor; someone who becomes the 'eyes and ears' of the deaf-blind person and forms a vital link in any reactive setting. The intervenor is not a model or a teacher or one who makes decisions on behalf of a deaf-blind person (although the intervenor may assist in these) but rather a communicator who communicates to deaf-blind people the visual-aural world around them and aids them in the interpretation of this information. (8) An intervenor's role is not simply one of an attendant; it is the vital link between the deaf-blind person and the hearing and sighted world. The majority of

deaf-blind individuals would require an intervenor to independently access our transportation systems.

In 1984 a task force, set up by the CNIB, reported on services to deaf-blind persons in Canada. Because of the voluntary reporting procedures used, the task force had difficulty in determining the exact number of deaf-blind persons in Canada. It identified 830 such individuals and estimated that there were between 1,500 and 2,000 deaf-blind persons residing in Canada.(8) There are no other reliable figures available on the number of visually impaired persons living in Canada with an additional disability. Some visually impaired persons may also experience additional disabilities which can further compound the complexities of independent travel.

In 1972 the National Center for Health Statistics (NCHS) in the United States surveyed combinations of impairments. A sample population of 14,497 persons between the ages of 4 and 74 was used. Based on the findings of this survey, the NCHS stated that of the estimated 47,424,000 non-institutionalized persons in the United States with some type of impairment, 1,306,000 persons had a severe visual impairment only and 5,020,000 persons had some level of visual impairment in combination with another impairment. The breakdown of impairment combinations is as follows:

Vision and hearing	2,559,000
Vision and speech	130,000
Vision and paralysis	256,000
Vision and absence of extremity	148,000
Vision and other orthopedic	1,927,000

These estimates are not of the legally blind population alone, although some legally blind persons are included.(1) The participation rate for this survey was only 73 percent. Researchers feel that this reduced participation rate resulted in an understatement of the prevalence of severe, visual impairments.

2.5 CANADA'S VISUALLY IMPAIRED POPULATION

The CNIB's latest statistics on client population show that there are 52,436 persons who have chosen to register for services with the CNIB. (See Appendix C). This figure is largely composed of individuals who have a severe visual impairment. CNIB and other consumer groups estimate that there are more than 268,000 individuals in Canada who experience visual impairment to the degree that it interferes with their daily functioning. This figure is rapidly increasing as the Canadian population ages. As of 1986 CNIB statistics for the incidence of visual impairment in the Canadian population over the age of 65 was 32,203 per 2.7 million individuals. Statistics Canada estimates that by the year 2000 there will be four million individuals in Canada who are 65 years of age and over. Barring unforeseen major ophthalmological advancements, one can project that by the year 2000 there will be close to 48,000 visually impaired individuals 65 years of age and over in the Canadian population.

Further analysis of the CNIB client population statistics reveals that for 1986 seven percent were children and adolescents; 32 percent were between the ages of 20 and 64; and 61 percent were over the age of 65. Additionally, of the 32 percent between the ages of 20 and 64, only 30 percent were employed. About four percent of the population were congenitally blind; the rest had lost their vision later in life and retained some usable vision. Less than 10 percent of the legally blind population use braille as the primary mode of written communication.

A study completed in the United States in 1980 estimated that of the number of legally blind persons in that country, 11 percent read braille and eight percent use it as the primary mode of communication. By age group: 52 percent of the legally blind population under 20 years of age learn braille, 20 percent of the 20-39 age group learn braille, 10 percent of the 40-64 age group learn braille, and three percent of the legally blind population over the age of 65 learn braille.(1)(9) On the other hand, some individuals who are congenitally blind, i.e. blind from a very young age, and who have used braille all their lives may not be familiar with the print alphabet or Arabic numerals. There are no comparable figures available for the Canadian visually impaired population.

HOW VISUALLY IMPAIRED PERSONS TRAVEL

3.1 GENERAL

To understand the impact loss of vision has on individual travel needs it is necessary to understand the heterogeneous nature of the visually impaired population. The abilities of visually impaired persons differ greatly. Their amount of useful vision and how effectively they are able to utilize this vision varies. Their level of orientation and mobility skills varies. They may choose different mobility devices to assist them in travelling. Their cognitive and psychological factors make each of them an unique individual. To meet the access needs of such a diverse population, design solutions must be found that are of assistance to the largest segment of the population.

The planning of barrier-free environments for visually impaired persons is frequently ill conceived. Accessibility issues are considered from an architectural or structural perspective only. This approach addresses only part of the problem. For most visually impaired persons the real problems center around: a need for orientation assistance; access to public information and communication systems; operational procedures; and — most importantly — the expectations and attitudes of people. Appendix D outlines specific services and assistance that transportation personnel may provide for visually impaired travellers.

3.2 ORIENTATION AND MOBILITY

Orientation and mobility govern how visually impaired persons travel independently in the environment. Orientation refers to the process of utilizing one's remaining senses to discriminate environmental information and establish one's position and relationship to other objects in the environment. Mobility refers to one's actual locomotion from a starting point to a desired location in another part of the environment. Sensory awareness and development are vital elements of effective orientation and mobility. It is commonly believed that the remaining senses of visually impaired people are superior; this is a myth. Visually impaired people simply learn how to utilize their remaining sensory apparatus more effectively to discriminate, interpret and process environmental information. Concept development is an especially important aspect of orientation and mobility for congenitally blind persons who have not had the benefit of early learning with vision. The congenitally blind person

must understand the multitude of concepts that govern how the environment is put together and how one moves with planned, purposeful direction in that environment.

When sighted persons experience a degree of difficulty in orienting themselves to unfamiliar environments, they rely primarily on their sense of vision to assist them with efficient planned movement. For someone with a visual impairment, who either cannot access available visual information or perhaps can only access a small part of it, it is much more difficult to maintain orientation and to move effectively in unfamiliar areas.

Visually impaired persons use a wide variety of techniques and devices to develop independent travel skills. Some visually impaired persons have developed independent travel skills through specialized orientation and mobility training. This training is individually prescribed and is provided by highly trained orientation and mobility specialists. It concentrates on the development of orientation and mobility skills by teaching specific techniques to be used in conjunction with sensory, concept and problem solving methodologies. Many visually impaired persons with low vision benefit from the use of a low-vision aid when travelling. An appropriate low-vision aid can be identified through a low-vision assessment prior to orientation and mobility training. The end objective of orientation and mobility training is to provide a visually impaired individual with independent, safe travel skills that can be used effectively in any new travel environment. (See Figure 2.)

While this training may sound ideal, in reality, visually impaired persons who have received orientation and mobility training possess differing levels of independent travel skills. This difference is due to the complex physical, psychological, and social makeup unique to each learner. Additionally, many visually impaired individuals cannot receive specialized instruction due to lack of local facilities or trained personnel. Therefore, while there are general statements that can be made regarding the various methods that visually impaired people use for travel, the fact is that there exists a wide variety of skill levels and methodologies that visually impaired persons employ in travelling.

Figure 2 Individual travelling through an airport terminal using residual vision paired with a long cane and touch techniques

3.3 METHODS OF TRAVEL

Visually impaired persons may choose to travel by depending upon a sighted guide in certain situations or they may choose to travel independently. For independent travel they may rely upon using their remaining vision and/or such aids as; a white cane, a guide dog or an electronic travel aid. An individual with a sufficient amount of residual or remaining vision may travel safely by learning to utilize this vision more effectively. For many individuals, visual efficiency can be enhanced through the use of appropriate low-vision aids and visual-efficiency training. An environment that has been well planned — with effective use of colour contrast, signage and illumination — can greatly add to such an individual's ease of travel, particularly in unfamiliar surroundings.

Many visually impaired people may have vision which they are able to utilize quite effectively in some travel situations. However, their vision is such that in order to assure safe, well-oriented travel, they utilize this vision in conjunction with a mobility aid such as a long white cane. The cane serves as a back-up system and, when used in conjunction with remaining vision, assists the individual with object detection, depth perception concerns and general orientation. For example, people with tunnel vision who may still have a high level of visual acuity often utilize their small central visual field to detect objects several metres away while clearing the area immediately underfoot by utilizing their long cane. Similarly, persons who experience visual acuity concerns may need to get very near objects in order to visually detect their presence and identify them. For these persons using a mobility device as a back-up system may prevent them from contacting an object that they were not able to see because of its size, position or colour contrast, or due to illumination problems in the environment.

Other individuals, experiencing eye conditions which result in 'night blindness', can often function visually quite well in environments with adequate lighting. But in settings with no illumination or with very poor illumination, these same individuals may have to rely almost entirely on a mobility device to ensure safe independent travel.

The remainder of the population who have a severe visual loss rely primarily on a mobility device to assure independent, safe travel. Individuals supplement this mode of travel with any small amount of residual vision they have, e.g. light perception can be used effectively to assist with orientation.

3.4 MOBILITY AIDS

The three most common mobility aids in the order of their frequency of use are: the long white cane, guide dog, and electronic travel aid.

3.4.1 The Long White Cane

The long white cane is used by many individuals who have received formal orientation and mobility training. Training with the long cane enables individuals to move with independence, grace, purposeful direction and safety in their environment. Coupled with other sensory information, the long white cane provides the user with information about the immediate environment and gives advance warning of gradient changes and obstacles in the path of travel.

The most common cane technique used in an unfamiliar environment is the 'touch technique'. As individuals walk along they systematically move the cane before them in a wide arc rhythmically touching to the left and right. In this way they clear a path of travel and determine textural differences in the path. With this technique, the long, white cane can safely detect objects that are below waist level and in the immediate environment. Obstacles projecting above the waist will not be detected unless they are properly identified at ground level.

In practice, a wide variety of cane techniques exist due either to the lack of formal mobility training or to user modification of the formal techniques. Some individuals use a shorter white cane to identify themselves as visually impaired and rely primarily on a sighted guide or the use of residual vision for travel purposes. Other individuals may use a white support cane to assist with balance and may pair this with use of residual vision or another mobility device as needed.

3.4.2 Guide Dogs

Approximately 600 visually impaired persons in Canada utilize guide dogs as their primary means of independent travel. This figure represents slightly more than one percent of the estimated legally blind population. Based on information released from North American guide-dog schools, it is believed that up to five percent of the Canadian visually impaired population could effectively use a guide dog as a safe means of travel.

Guide dogs are not pets. (See Appendix E.) They are trained to stop at elevation changes and to lead their owners around obstacles and away from overhanging protrusions. An established guide-dog school provides specialized training to the young dog in order to prepare the animal for its future guiding role with a visually impaired person. This training continues with both owner and guide dog once they have been teamed at the school. Safe and efficient use of a guide dog requires specific personal, physical and cognitive characteristics in the prospective owner. For example:

- most guide-dog schools require individuals to be at least 18 years of age to ensure the level of maturity and responsibility dog ownership requires.

- owners must be able to function cognitively at a level consistent with giving effective and safe directions to the guide dog. Although guide dogs have received highly specialized training, they rely on their masters for commands and travel decisions. For example, the guide dog does not initiate a street crossing when the traffic light changes colour: the dog waits for the command to cross from the visually impaired owner who determines the correct time to cross by listening to auditory traffic flow patterns.

- owners must take the responsibility for reinforcing the dog's training. The dog guide is trained to go around overhanging obstacles and obstacles which project into the environment above waist height for example. However, this important component of training can be forgotten if it is not regularly reinforced.

- the physical health of owners must be such that they are able to provide the guide dog with adequate exercise, and that they can keep pace with the average three to five kilometres-per-hour speed at which most guide dogs travel.

- the owners must have sufficient visual impairment so that they do not create confusion in the guide dog by relying more on the use of vision than on the guide dog. This could interfere with the important trust and working relationship between dog and user.

To be an effective and safe mobility aid the guide dog must continually receive the proper balance of discipline and praise from its owner. Without this balance, a dog may eventually become ineffective as a mobility aid.

3.4.3 Electronic Travel Aids

A small percentage of visually impaired travellers choose to utilize an electronic travel aid to assist them with independent travel skills. The majority of these devices are secondary mobility aids used in conjunction with a guide dog or long cane. Electronic travel aids use infrared light or high-frequency sound waves to provide the user with greater advance warning of obstacles and/or elevation changes than a long cane can. For some visually impaired individuals electronic travel aids have proven quite helpful.(10) This is especially true for persons with additional physical impairments that interfere with travel methods, e.g. peripheral neuropathy (commonly associated with diabetes mellitus) might cause loss of sensation in the hands and feet making tactile detection of drop offs with the long white cane difficult.

Not all visually impaired persons can benefit from electronic travel aids. For some individuals, trying to interpret the additional sensory information given by the device may be too complex or tiresome. For others, without funding sources the initial purchase price may be too high. The most popular of the aids currently available are Mowat Sensor*, Laser Cane**, and Sonicguide***. (See Appendix A.) In order to employ these devices effectively, the manufacturer of each device recommends specialized training programs for users.

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* Mowat Sensor is trademark of Wormald International Sensory Aids Corporation

** Laser Cane is trademark of Nurion-Industries

*** Sonicguide is trademark of Wormald International Sensory Aids Corporation

REVIEW OF ACCESSIBILITY STANDARDS

4

4.1 INTRODUCTION

Overall, we found that a lack exists in our building guidelines, codes, and standards regarding accessibility recommendations for visually impaired persons. The majority of documents reviewed focused largely on accessibility for physically disabled persons and contained very little, if any, material on adaptations and design concerns for sensory impaired persons. Where documents did contain information specific to the needs of visually impaired persons, the design elements outlined (e.g. tactual markings, cane clearance dimensions) were frequently geared more to the needs of the totally blind traveller rather than to the low vision needs of the larger visually impaired population.

Viewed in a positive light, this lack in the standards would suggest that there is much room for informed advocacy and consultation concerning the needs of the visually impaired traveller. This dialogue is to be addressed to the bodies responsible for formulating and updating the standards. We also found some discrepancies among existing standards regarding access recommendations for visually impaired persons.

There is no single document that can be considered as the definitive standard for access requirements to buildings for visually impaired persons. In this chapter we identify and review the nine documents that largely govern building design in Canada with respect to accessibility. The building design elements covered by the accessibility sections of each standard are reviewed and analyzed from the perspective of the needs of the visually impaired population. The current situation in each Canadian province with respect to applicable building codes is also addressed.

The codes, standards and guidelines reviewed are:

- National Building Code of Canada, National Research Council.
- Alberta Building Code, 1985, Ministry of Labour.
- British Columbia Building Code, 1985, Ministry of Municipal Affairs, Section 3.7.: The Section 3.7 Handbook, British Columbia Building Code, 1984, Ministry of Municipal Affairs.
- Manitoba Building Code, 1981, Department of Labour and Manpower.

- Building Code Act, Chapter 3, Statutes of Nova Scotia, 1986, Regulations Made Pursuant to Section 4 of the Building Code Act, Statutes of Nova Scotia, 1986.

- Ontario, The Building Code, 1986, Ministry of Housing; Guide and Illustrations for Section 3.7 of the Ontario Building Code, Ministry of Housing.

- Accessibility Standards Guidelines, Saskatchewan Human Rights Commission, 1985.

- American National Standards for Buildings and Facilities Providing Accessibility and Usability for Physically Handicapped People, American Standards Institute, 1986.

- Barrier Free Design Accessibility to, and use of, Buildings by Physically Disabled People, Public Works Canada, 1985.

4.2 BUILDING CODES WITHIN CANADA

The National Building Code of Canada is used throughout Canada as a basis for provincial building code legislation. Four provinces, Alberta, British Columbia, Manitoba and Ontario, have separate provincial building codes which include the standards set out by the National Building Code of Canada and certain other standards. The provinces of Nova Scotia and Saskatchewan have adopted the National Building Code of Canada as the actual code for the province and also retain legislation related to implementing accessibility standards. All other provinces and territories (New Brunswick, Newfoundland/Labrador, Northwest Territories, Prince Edward Island, Quebec and the Yukon) have adopted the National Building Code of Canada as the code for their jurisdictional areas.

The national and provincial building codes each include sections related to barrier-free design/accessibility.

4.2.1 National Building Code of Canada, 1985

Section 3.7, Barrier Free Design, of the National Building Code of Canada relates to information access, general occupancy requirements and design standards. The code specifies: how barrier-free access is defined; when such access is required; and signage, e.g.

labelling areas as accessible. Specific standards are given for: seating areas (wheelchair numbers), parking-area access, walkway access, washrooms, doors, vestibules, ramps and elevators/elevating devices.

The Code deals specifically with visual impairment access issues in the following design areas:

- construction and obstructions in corridors (i.e. long cane clearance dimensions) section 3.3.1.7.(3)(4);
- handrails for stairways section 3.4.7.5.(5)(6)(7);
- tactile signage for exits and elevators sections 3.4.7.12.(18), 3.5.5.1.(4).

The National Building Code is a very important document because it serves as a model for provincial building codes. The National Building Code is amended every five years. The most recent amendment in 1985 saw more concern focusing on the needs of visually impaired travellers. This trend notwithstanding, the National Building Code still has very limited content directed toward the access needs of visually impaired persons. The design elements noted above are a start, but even those elements require greater depth and direction. For example, the information on tactile signage specifies letter height and depth of relief but does not address type style or stroke width to height and character width to height ratios.

In summary, at this time the National Building Code has simply not taken a leadership role in the advancement of design accessibility for visually impaired persons in Canada.

4.2.2 Alberta Building Code

The Alberta Building Code utilizes The National Building Code as its base document, and repeats the recommendations set out in the National Building Code of Canada l985, with respect to barrier-free design. Barrier-free design criteria under section 3.7 relate to: applications, balconies, building controls, design, doors/entrances, elevators, floor surfaces, lavatories, ramps, shower stalls, accessibility, signage, soap and towel dispensers, special washrooms, exterior walks, parking areas, vestibules, washrooms generally, and wheelchair space.

No recommendations, other that those cited in the National Building Code of Canada, have been incorporated into the Alberta Building Code with respect to accessibility for visually impaired persons. There-

fore the same comments apply to this Code as apply to the National Building Code (4.2.1).

4.2.3 British Columbia Building Code

The British Columbia Building Code contains an extensive section on building requirements for persons with disabilities. The exemptions clauses are very specific and relate to occupancy requirements, floor space in a structure, building classifications and areas where disabled people may not necessarily be employed.

Standards for accessibility are cited by the British Columbia Building Code under the following subject headings: scope, definitions, applications, exemptions, existing buildings, stairs and handrails, passenger elevators, design requirements, specific requirements, entrances, work areas, washrooms/areas of refuge, and design requirements for Group A — F buildings.

The group A — F structural standards include: public toilets, ramps, parking stalls, main entrances, door assemblies, aisles, restricted passageways, food service lines, floors, elevators, tactile warning strips, warning systems, directional guides, washrooms, bathrooms and showers, sleeping units, viewing positions, public telephones, drinking fountains, teller locations, areas of refuge, and additions to existing buildings.

The British Columbia Code has substantial building code considerations relating specifically to visually impaired persons. These codes are given in section 3.7.3 under the following headings: elevator control design, handrail design, tactile warning strips for stairs, warning systems, room numbering and egress.

In order to assist designers, contractors and builders, the British Columbia Department of Municipal Affairs has published a Section 3.7 Handbook. This handbook contains explanatory notes regarding the implementation of section 3.7. The handbook is an excellent tool, easy to decipher and clearly providing the reasoning behind each recommendation.

The British Columbia Building Code has taken a progressive and informed leadership role in Canada regarding accessibility recommendations specific to the needs of visually impaired persons. In developing specific design recommendations for our report, we have elected to draw from the British Columbia Building Code whenever possible. We believe that the British Columbia Building Code has made an excellent

contribution toward increasing environmental accessibility for visually impaired persons.

At the same time, we believe that there are areas within the British Columbia Building Code which could be improved upon. Even though the Code is far ahead of most other Canadian documents regarding accessibility suggestions for visually impaired persons, there are many more recommendations (see Parts 5 and 6) that could be added in future amendments. Some recommendations within the Code could also be more clearly defined to assist design personnel. For example, while signage is covered in some detail regarding tactile qualities, dimensions, and colour contrast, there is no specific information to indicate the importance of standardizing general information, non-tactile signage with respect to print size and expected viewing distance.

We also note that a slight discrepancy appears to exist in the recommendations for raised tactile signage. The dimensions regarding the depth of character relief differs depending on the location. For example:

- for elevator control panels, section 3.7.3.13.(2) specifies a raised minimum of 1 mm,
- for doors and openings, section 3.7.3.19.(1) specifies a raise of 3 mm, and
- for stairwell floor numbers, section 3.7.3.20.(2b) specifies a raise of 0.7 mm.

Section 3.7.3.16.(1) of the British Columbia Building Code outlines a tactual warning system to be used to alert persons to the onset of stairways. The findings from our research (see 6.2.5 and 7.3.1) indicate that such a recommendation is premature and should await further research to confirm uniform and standardized characteristics for materials that could serve as the detectable warning surface for stair systems, curbcuts, and elevated platforms.

Finally, it is of utmost importance to note (see 6.2.13) that there exists a contradiction between the American National Standard for Buildings and Facilities (ANSI) and The British Columbia Building Code. The former recommends texturing door handles to warn of a hazardous area; the latter recommends texturing door handles to indicate building exits. This contradiction is a major concern that must be resolved between the two guidelines. The existence of such a major contradiction

in these widely used documents could lead to serious safety concerns and misinformation for the visually impaired traveller.

4.2.4 Manitoba Building Code

The Manitoba Building Code, Section 3.2.7 is entitled 'Provision for physically handicapped persons'. The section refers in part to 'Building standards for the handicapped l980'. These 1980 standards require updating if they are to be retained within Section 3.2.7.

Section 3.2.7 also provides accessibility standards for entrances and access to public spaces on the entrance floor. It defines the need for access to at least one elevator and washroom.

No recommendations relating specifically to accessibility for visually impaired persons, other than what is encompassed within the National Building Code, are contained in the Manitoba Building Code. Therefore, the same comments apply to this Code as to the National Building Code (4.2.1).

4.2.5 Building Code Act, Chapter 3, Statutes of Nova Scotia 1986

The Building Code Act indicates that Nova Scotia accepts the National Building Code of Canada as the standard document for construction of buildings in Nova Scotia.

No recommendations relating specifically to accessibility for visually impaired persons, other than what is encompassed within the National Building Code, are contained in the Building Code Act, Chapter 3, Statutes of Nova Scotia 1986. Therefore, the same comments apply to this Code as to the National Building Code (4.2.1).

4.2.6 Ontario Building Code

No recommendations relating specifically to accessibility for visually impaired persons, other than what is encompassed within the National Building Code, are contained in the Ontario Building Code. Therefore, the same comments apply to this Code as to the National Building Code (4.2.1).

4.2.7 Accessibility Standards Guidelines 1985 adopted by the Saskatchewan Human Rights Commission

These standards present more complete coverage and detail than the National Building Code of Canada regarding the needs of visually impaired persons. They are meant to be used as guidelines for building and design personnel. The subject matter covered includes: exemptions, applications, exterior paths of travel (such as walks, ramps, curb ramps, and pedestrian crossings), sight furniture, parking stalls, and entrances. Entrances are further broken down as follows: major entrances, exterior paths of travel, ramps, doorways and doors.

Other subjects covered include: aisles; restricted paths of travel; vertical access (such as elevators, elevating devices, and stairs), handrails, warning systems such as tactile cues and fire alarm systems, direction and information guides (such as signs, room identification, egress guidance, and information display units), depots, washrooms, bathrooms and showers, viewing facilities, public telephones, floor surfaces, location and mounting heights, built in fitments and casework, residential occupancies, and recreational facilities.

Sections relating primarily to the access needs of visually impaired persons cover the following topics: curb ramps, pedestrian crossings, site furniture, doors, interior and exterior paths of travel, elevator controls, emergency telephones and signage, stairs and handrails, warning systems, signage, room identification and egress.

While The Accessibility Standards Guidelines are to be commended on the effort to go beyond many of the other documents we review here, it is unfortunate that many of the dimensions and recommendations listed are not more in keeping with existing documents such as the British Columbia Building Code. Standardization is very important for a visually impaired traveller. It is not possible to achieve a standard presentation when various documents recommend different dimensions and adaptations for the same elements of building design.

Specifically, The Accessibility Standards Guidelines appear to recommend interior and exterior clearance dimensions which, for the most part, preclude any projections in the main path of travel that extend more than 100 mm into the path. While this may seem ideal, in reality it may prove to be difficult to meet; most other documents reviewed here, when commenting on clearance dimensions specifically for visually impaired persons, take into account the ability of the long cane to detect objects mounted at or below 650 mm.

While The Guidelines take into consideration the need for some sort of tactile warning system for visually impaired persons, again we consider specifics on placement and universal adaptation of such a system premature until further research is completed (6.2.5 and 7.3.1). Additionally, the recommendations in The Accessibility Standards and Guidelines for the use of a tactile warning system suggest wide usage of the system rather than limiting its use to specific design elements. For example The Guidelines suggest the warning system be used at the top and bottom landings of stairs and ramps; for any possible hazards within and near paths of travel; and to warn of conflicts between pedestrian and vehicular travel routes. This broad recommendation of usage could result in a lot of individual interpretation and usage of such an important warning system.

In summary, The Accessibility Standards Guidelines make a good attempt to provide more awareness of the needs of the visually impaired person. However, some of the recommendations rather than building on earlier documents already in use, differ from these documents, i.e. The British Columbia Building Code and the American National Standards for Buildings and Facilities (ANSI). The Accessibility Standards Guidelines, while attempting to give more focus to the needs of the visually impaired person, could expand this focus and provide many more recommendations to increase accessibility for visually impaired persons.

4.3 STANDARDS/PUBLICATIONS IN USE WITHIN CANADA

The following publications offer valuable information and guidelines for terminal designers and operators. Several of them are cited in the provincial building codes as reference material.

4.3.1 American National Standards for Buildings and Facilities Providing Accessibility and Usability for Physically Handicapped People

The American National Standards Institute (ANSI), located in the United States, is well recognized throughout North America for standards set out for disabled persons. Their standards are partitioned under the following headings: purpose and application, recommendations to adopting authorities, graphics, dimensions, referenced standards and definitions, accessible elements and spaces, accessible routes, protruding objects, ground and floor surfaces, parking spaces and passengerloading zones, curb ramps, ramps, stairs, elevators, platform lifts, windows, doors, entrances, drinking fountains, water closets, toilet stalls, urinals, lavatories, sinks and mirrors, bathtubs, shower stalls, storage, grab bars, tub and shower seats, alarms, detectable warnings, signage, telephones, seating, tables, work surfaces, auditoriums and assembly areas, and dwelling units.

Information relating specifically to standards for visually impaired persons is given under the following headings: accessible routes, headroom, surface texture, protruding objects, curb ramp design, ramp design, stair design, elevator design, detectable warnings, signage, and telephone enclosures, design and location.

Along with The British Columbia Building Code, some recommendations in our report are based in part upon recommendations from ANSI.

While ANSI provides some focus on the needs of visually impaired persons, our report suggests other adaptations and recommendations for visually impaired persons that are not currently listed within ANSI. A section on detectable warnings is in the 1986 ANSI standards. However this section is being withdrawn in revisions now underway.

4.3.2 Barrier-Free Design Accessibility to, and Use of, Buildings for Physically Disabled People

This publication is based on section 3.7 of the British Columbia Building Code and is aimed at providing standards for accessibility to public structures. The following topics are covered: circulation, washrooms, drinking fountains, parking spaces, counters, cafeteria lines, telephones, vending machines, lockers, and alarm poles and signage.

Standards which apply specifically to visually impaired persons include those relating to: passageways, handrail design, curb ramp design, stair design, washroom accessories, drinking fountain locations, telephone enclosure design, and signage.

Again the British Columbia Building Code is to be commended for its coverage of design aspects related to visual impairment. The attempt of the Barrier Free Design publication to utilize the British Columbia Building Code as its base document is viewed positively from the aspect of attempting to standardize recommendations for visually impaired persons in Canada. However, the document did not go beyond those recommendations outlined in the British Columbia Building Code and we believe that further suggestions and adaptations can be implemented which will increase accessibility for visually impaired travellers.

GENERAL DESIGN RECOMMENDATIONS

5

5.1 GENERAL

The philosophy behind the development of this section is one of reasonable access to transportation terminals. Society must continue to provide and upgrade appropriate educational and training opportunities for visually impaired persons in order to provide them with the necessary skills and problem-solving tools to adapt to living in an environment designed primarily for sighted persons. At the same time, within the guiding principle of reasonable access, there is a great deal that can be done — for the most part at reasonable cost — to enhance our current travel environments.

A well-designed environment supports effective orientation and mobility: It is clearly organized; free of hazards; and presents adequate information about location and direction. Criteria for design modifications to aid visually impaired travellers must respond to their need to travel independently, safely and purposefully (11).

Building designers must give consideration to the needs of visually impaired travellers when buildings are in the initial stages of design (12). Designers must recognize that visually impaired persons can function independently in the mainstream of society, and question the predominant reliance upon vision to direct the travelling public. In this way inequities in ease of access can be prevented (1). Current way-finding literature states that buildings which are poorly designed tend to rely far too much on a barrage of visual signage in an attempt to resolve the general public's confusion. However rather than resolving the confusion, this information overload often results in more frustration and confusion. Similarly, an element of a building placed correctly in the design stage, will not require that a costly — and possible unsightly — safety-rail be added to it after construction is finished.

We present here a set of perspectives from which to address transportation terminal design for the greater good of both visually impaired and sighted travellers. A summary of general design considerations is given immediately following each sub-section for easy reference.

5.2 CONSULTATION TEAM

To assist designers, we recommend the formation of a consultation team. The information in this manual cannot be used effectively in isolation. Many of the recommendations made must be carefully weighed with respect to specific environments and user requirements. A carefully selected local consultation team can provide detailed, on-site analysis of the environment and provide specific input on accessibility for the site in question. In order to provide a broad, well balanced perspective, the consultation team should be composed of: several visually impaired consumers who demonstrate a wide variety of mobility methods, visual functioning levels and personal travel experiences; an orientation and mobility specialist; a low-vision specialist; and appropriate building management and design specialists. Care must also be taken to ensure that design suggestions and modifications do not conflict with access needs of other special-needs groups.

Recommendations

(i) Form a local consultation team to provide detailed, on-site analysis of the environment and to provide specific input on accessibility for the site in question.

(ii) Select for the team several visually impaired consumers; an orientation and mobility specialist; a low-vision specialist; and appropriate building management and design specialists.

5.3 ORIENTATION

There is a distinct and important difference between the navigation techniques of severely, visually impaired people in a familiar setting as compared to an unfamiliar setting. For most buildings or sites, visually impaired people will require information and/or assistance to facilitate their orientation on the first visit (11).

Many visually impaired persons develop a mental image of the space they are travelling through. This mental image is sometimes referred to as a cognitive map. The complexity of the image depends upon the cognitive ability of the traveller and his level of exposure to movement within the space. Initially the mental image consists of direct and simple information; such as the shape of a route and landmarks along the route. As individuals are exposed to further movement experiences in a specific space, they gain a greater understanding of more complex interrelationships of objects and points. Therefore, as people become more familiar with the space they are travelling through, the image develops to give a more integrated and a real perspective of the space.

Visually impaired people who are just getting to know a setting use a sequential strategy for finding their way. For example, to get from an office to a restroom a visually impaired person finds the way by following a memorized route from corridor-to-corridor without knowing the spatial relationship of the rooms. This strategy is similar to the type of instructions one gets when driving in an unfamiliar area — go straight, passing two traffic lights then turn left, turn right, etc. Thus a sequential strategy emphasizes a string of landmarks without providing the relationship between them (11).

A good building design is one that is straightforward and easily understood by people with impaired vision. First-time users find sequential wayfinding easiest; building designers can provide for this by supplying clear signs and landmarks that visually impaired persons can follow in a point-to-point strategy. Building design can also assist with the more complicated process of understanding spatial relationships by providing tactile and visual orientation aids, and by incorporating simple circulation patterns (11).

Ambiguous and poorly defined settings present orientation difficulties (11). To minimize these difficulties, the general design of the

building should focus on distinctiveness and simplicity with sufficient accessible information regarding the environment. Light and sound can be used to offer orientation cues. Colour brightness/contrast can be important in distinguishing different parts of the environment. Well designed tactile cues provide another source of orientation assistance (12). Visually impaired travellers depend on well defined paths and memorable landmarks to find their way.

Paths are defined by environmental shorelines. The edge of a carpet strip, a wall, the grass at the edge of a sidewalk, or a textured strip incorporated into the paving surface itself can all serve as shorelines that a cane or low-vision traveller may follow.

Landmarks are permanent objects or places that are memorable because of their distinctive qualities of sound, temperature, reverberation, smell or texture. For the low-vision person, landmarks may also include colour, light or other visual contrast. Additional area information may be gained through: non-directional sound from a crowd that tells travellers that they are in a lobby area; an audible, directional signal located over an elevator or restroom; or a tactile map with colour/brightness cues for low-vision travellers coupled with an auditory message tape that describes an area (11).

Finally, the design and the operational use of the building should be consistent and uniform. These elements particularly make it much easier for the visually impaired traveller to develop a cognitive map of an area, to know what to expect when moving independently through the space, and to locate something that is needed in that space. Consistency should be reflected in the overall design of the building: its floor plan, furnishings, and fixtures. Information systems should be similar throughout the building using uniform access and communication techniques. Travel information on schedules, routes, fares, and location of connecting ground transportation, etc. should be available in advance via a telephone information line and portable orientation aids. These aids, such as audio tape maps and tactile/low-vision maps designed to provide information to both totally blind and low-vision travellers, should be made available to the visually impaired person upon request.

Recommendations

(i) *A good building design is one easily understood by people with impaired vision. Include design elements which assist visually impaired travellers such as:*

- *consistency and uniformity,*
- *well-defined and detectable paths and landmarks,*

- *building plan, pavements, roads and paths kept to a right-angled system,*

- *elevators, stairs, and reception desks readily accessible.*

(ii) Break down large open areas into smaller areas. This can be achieved by the placement of furniture and/or the use of distinctly different floor surfaces e.g. colour, resiliency, textural, sound contrast. (See Figure 3.) The texture, illumination, colour, and sound absorption qualities of the walls and ceiling can also be varied in order to create sensory differentiations of large spaces.

(iii) Eliminate large unmarked expanses of glass and mirrored surfaces. Such surfaces are particularly confusing and disorienting to the low-vision traveller.

(iv) Provide advance travel information via telephone; provide portable orientation aids upon request.

5.4 MOBILITY

Directed and purposeful travel for a visually impaired person involves not only orientation to the environment, but also the ability to move gracefully through the environment. (See Figure 3.) Textured, light-coloured linoleum set into a dark-coloured carpet area is used to define main circulation routes in a terminal, so that the person may arrive safely at a travel objective. For visually impaired persons part of safe movement in an unfamiliar environment is being able to manoeuvre safely around obstacles and travel hazards.

An obstacle is defined as an architectural or environmental obstruction in the path of travel that can be easily detected and negotiated with standard long cane techniques, effective use of residual vision or other mobility techniques. (The long cane can only detect objects that are at waist height or below, and even objects at waist level are generally not detectable within a safe warning distance.) The environment is full of obstacles for the visually impaired traveller. (See Figure 4.) Obstacles that are permanent and easily detectable may actually serve as landmarks for the visually impaired traveller (2).

Figure 3 **Textured light-coloured linoleum set into a dark-coloured carpet area is used to define main circulation routes in a building**

The entire far wall of this room is mirrored and the lack of any colour brightness contrast creates a very confusing environment for the low vision person

The unexpected low floor sign and the truck extending over the sidewalk are both detectable with proper use of mobility devices, however both objects are travel obstacles and can be disorienting to the visually impaired traveller

Figure 4 Examples of travel obstacles

A travel hazard is defined as an architectural or environmental obstruction in the path of travel that cannot be easily detected and negotiated with standard long cane techniques, effective use of residual vision or other mobility techniques. Examples of travel hazards are: metal support cables for utility poles, some public telephones, stairs with open backs, some store windows, incorrect placement of railings on stairs, irregular intersections with offset corners, and curb ramps designed with only the wheelchair traveller in mind (2). (See Figure 5.) Appendix F outlines other architectural hazards frequently encountered by visually impaired travellers.

The path visually impaired people remember is the one they experience; not the one experienced by the sighted designer. What may appear straightforward and uncluttered to the fully sighted traveller, may be confusing and difficult to travel through for the visually impaired traveller. For example, a square room with much equipment against the walls may be experienced as hopelessly complex by a visually impaired person who is trailing a hand (or cane) along a wall. However, if a clearly differentiated surface is constructed for the main walkway the room may be relatively simple to navigate. This surface may be defined by texture, resiliency, audition, illumination and/or colour/brightness contrast.

Recommendations

(i) Understand the mobility needs of visually impaired persons.

(ii) Analyze building features from the perspective of these needs to minimize obstacles and eliminate travel hazards.

Figure 5 Examples of travel hazards

5.5 SENSORY INFORMATION

A well designed environment is one which is easy to navigate in and which provides the traveller with a rich, readily accessible array of sensory information. It does not present travel hazards, sensory deprivation or information overload. To achieve good design requires that design personnel have an understanding of the sensory information needs of the visually impaired traveller.

In addition to using any residual vision he possesses, the visually impaired traveller utilizes many non-visual cues in conjunction with the mobility devices described in 3.4. Non-visual cues include: tactile information, air movements, smell, sound, and changes in air temperature. The sound of doors opening and closing, the arrival of elevators, variations of background noise, conversation, and vehicular and pedestrian traffic noises, all create non-visual landmarks. Some buildings offer primarily visual cues to direction finding. Most visually impaired persons need the addition of non-visual information.

To the visually impaired person with usable vision, the design of the visual environment is even more important than to the sighted person. Individuals with low vision require very high-quality visual information e.g. optimum use of colour/brightness contrast to enhance the environment, the avoidance of visual noise, proper illumination, absence of glare, good contrast between printed information and its background, and satisfactory proportions for letters and signs (11). (See Figure 6.)

It is good practice to pair the non-visual sensory information with the visual. For example if cane-detectable, textured, warning surfaces are used underfoot throughout a building, these surfaces should include a highly colour/brightness contrasted, visual component. Thus persons who are not using a cane and are relying primarily on their residual vision have an opportunity to receive an advance visual warning. This pairing of non-visual cues with visual cues enables travellers to confirm their visual perceptions and to compensate for visual distortion by integrating their vision with other sensory information. Through this pairing of cues, the designer is able to meet the individual needs of a larger segment of the visually impaired population.

Recommendations

(i) Use only very high-quality visual information: E.g. make optimum use of colour/brightness contrast to enhance the environment; avoid visual noise; use proper illumination; eliminate glare through the use of matte and non-glare surfaces; ensure good contrast between printed information and its background; use recommended proportions for letters and signs (11).

(ii) Provide non-visual information to supplement and enhance the visual environment. Consider the use of sound, air movement, smell, tactile information, etc., for communicating with and directing travellers.

(iii) Where possible, pair non-visual sensory information with visual information.

5.5.1 Vision

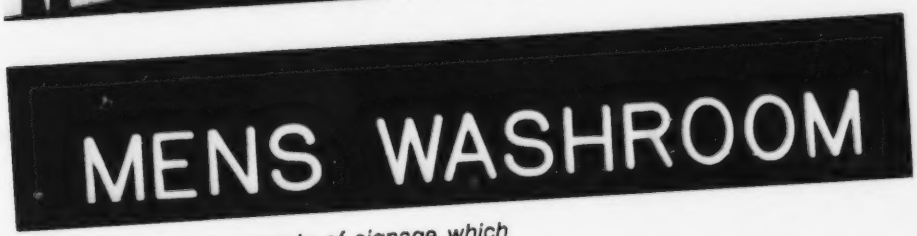
(a) Colour/Brightness Contrast

Lighting and colour schemes cannot be treated separately. Even optimum illumination may not assist a visualiy impaired person to travel safely through an environment if objects and their surrounding areas present very little colour/brightness contrast. Conversely, the eye is sensitive to colour experiences only if the strength of light is sufficient to stimulate the eye. The level of light, however, must not be overpowering or misdirected so as to cause glare; glare tends to veil and minimize colour contrast.

Colour is a complex, subjective phenomenon even for the normally sighted individual. The effects of specific eye conditions — glaucoma, diabetic retinopathy and arteriosclerotic retinopathy — on vision and the ability to detect colours have not been clearly established in the literature. While it is known that many eye conditions cause distortion of colour vision, due to the uniqueness of each individual's low vision specific colour deficits have not been uniformly linked to specific eye conditions. However, it is known that the most common difficulty experienced for people who are colour blind occurs in the red and green area of perception. Reds and greens are seen as varying shades of gray. Congenital colour blindness affects about nine percent of all males and two percent of all females.

Studies demonstrate that up to 48 per cent of the elderly who were not formerly colour blind will also experience minor to severe

(a) A woman is able to read orientation signage in a terminal by using her low-vision aid, a monocular



(b) A very good example of signage which is also tactual. The sign has a matte non-glare surface

(c) The placement of this sign and its shiny surface characteristics create so much glare that parts of it are illegible

Figure 6 Examples of well and poorly designed signage

changes in their abilities to name or identify colours accurately (13). The lens of the eye yellows with age and the environment tends to take on a yellowish-brown tint. Colour discrimination becomes more difficult, particularly in the blue range of the spectrum. Also fine discrimination between dark colours (black, charcoal, navy, maroon, brown) and between light colours (pastel pink or yellow, beige, off-white, lavender) is impaired.

Colour is specified by its three components; hue, saturation or chroma, and brightness or intensity. Hue is the sensory correlate of wave length. The names of the primary colors designate hues. Saturation or chroma refers to the strength or richness which a hue appears to possess. A stronger hue is said to be more saturated. Mixing white light with a color dilutes it: white added to red turns it pink. Brightness or intensity is the relative amount of light reflected by a particular hue. Brightness value can be altered while hue and chroma remain constant.

Under optimal illumination conditions, all persons having useful vision are able to perceive at least some differences in brightness, while many have difficulty discriminating different hues. Therefore, the primary guiding principle in colour selection should be choice of colour combinations with excellent contrast in brightness (1). The experience of colour is at its maximum with orange, yellow and light green colours, but decreases with red and violet colours.

Our recommendations regarding colour contrast adhere to those found most frequently in the literature. Findings from the 1984/85 Workshops on Signage for Blind and Visually Impaired Persons recommended that colours used in combination with each other should differ in brightness value from each other by a factor of at least 70 percent (14). This brightness contrast should be based upon the following formula:

$$\text{Contrast} = \frac{B1 - B2 \times 100}{B1}$$

Where B1 = reflectance of brighter area
B2 = reflectance of darker area

Recommendations

(i) *Use yellow, orange or white on a dark or black background to achieve optimum visibility for the majority of the visually impaired as well as the normally sighted population (1). Yellow and orange appear to be the most discriminable colours (hues)*

to the normal eye, the aging eye, the visually impaired eye, and the colour-blind eye (15) (16) (17).

(ii) When designing with colour against surrounding backgrounds, unnecessary visual clutter and confusing pattern must be eliminated. Many visually impaired persons experience figure-ground confusion.

(iii) Carefully selected colour should be used to emphasize important features in a room and to assist with orientation. Efficient and consistent use of a planned colour scheme can make orientation and travel safer and more effective. For instance a single colour should be used for all emergency exits from a building and all emergency apparatus such as: fire alarm stations, direct-line telephones, and first-aid equipment. Efficient planning of colour scheme systems can result in an environment which is both aesthetically pleasurable and systematically efficient.

(iv) Use colours which contrast in brightness and hue to make signs and room numbers more visible, to contrast door knobs and frames from the surrounding wall area, to call attention to the area leading to staircases and to step edges, to make handrails stand out from the surrounding wall surface, and to highlight the edge of open railway platforms and other drop-off areas (18). (See Figure 7.)

(v) Use colour coding to assist with way finding. A complex terminal might colour code certain wings to assist with orientation.

(vi) Where possible, pair colour with other sensory information, e.g. a coloured lip of the step edge paired with a discriminable texture.

(vii) Where colour/brightness contrast is used, the colours should differ in brightness value from each other by a factor of at least 70 percent based upon the following formula:

$$\text{Contrast} = \frac{B1 - B2 \times 100}{B1}$$

Where $B1$ = *reflectance of brighter area*
$B2$ = *reflectance of darker area*

(b) Illumination

The Illuminating Engineering Society defines light as radiant energy evaluated according to its capacity to produce visual sensation. Light is measured in a unit called lumen-hours (lm-h); the symbol is Q. Illumination is the result of light falling on a surface and is measured in foot-candles or lux. One lux = 0.0929 foot-candles (19).

Factors that influence how well a visually impaired person is able to see objects in the environment include: the time available to focus accurately on an object; the size of the object; the brightness of the object; and the contrast between the object and its immediate background.

Unfortunately there are no reliable rules governing the level of illumination required by individuals with various eye pathologies. Individual lighting requirements vary considerably, even among patients with the same eye pathologies. However, most experimental research substantiates the fact that although a few eye pathologies may require reduced levels of illumination, most visually impaired persons benefit from increased levels of illumination in general and from individualized lighting systems which can be focussed and adjusted in a controlled setting (20) (21) (22) (23).

While illumination must be adequate to enable visually impaired persons to utilize their vision effectively, it must also be directed and controlled so that it does not create glare. Lens and corneal problems can mean that individuals experience more problems with glare and will be more sensitive to light, especially if it is directed right into the eye. Hence, the direction and spread of the light within the environment is also important. Designers should understand the benefits and shortfalls of different kinds of light — fluorescent, incandescent, and natural — with respect to the needs of visually impaired travellers. Appendix G reviews the characteristics of various kinds of light.

The level of illumination must be consistent throughout a setting. Many visually impaired persons experience problems with light adaptation, the adjustment of the eye from one level of lighting to another. Physiologically the eye adapts more quickly from dark to light conditions than it does from light to dark. Most sighted individuals experience an interval of diminished vision upon leaving a dark theatre and encountering bright sunlight. For people with normal visual functioning this interval lasts only a few minutes; for a visually impaired person with severe adaptation problems, the interval can last for several hours.

(a)

Actually shows a picture of a stair system with three steps. The terrazzo brick pattern and lack of any contrasting nosings completely obscure the stairs

(b)

Shows a similar stair system which is much more visible due to the contrasted nosings

(c)

Shows another example of the high visibility created by contrasted nosings

Figure 7 Stairs

Spectacle filtering lenses can be helpful to those visually impaired individuals requiring less illumination. The lenses filter out certain wavelengths of light and enhance the colour/brightness contrast in the environment. Some visually impaired persons may use filtering lenses with a yellow, red or darker tint to eliminate glare indoors or outdoors, and to ease the time necessary for visual adaptation to extreme lighting conditions.

Due to changes in the aging lens, the elderly population as a whole requires higher levels of illumination. An 80-year old needs at least three times as much light on a task to see with the same clarity as a 20-year old. However, many elderly people are also more sensitive to glare due to changes in the lens from the natural aging process (24).

The basic requirement is to get enough, but not too much light, where it's needed without glare and with a consistent and controlled distribution of light from area to area. Due to the heterogeneity of the visually impaired population, the answer for establishing illumination level requirements in transportation terminals and other public buildings lies in finding a medium level of illumination that would be able to benefit the greatest number of visually impaired and sighted persons (25). With this point in mind it is recommended that the Illuminating Engineering Standards (IES) as outlined for transportation terminal settings in the IES Lighting Handbook Applications, 1987, be followed.

Recommendations

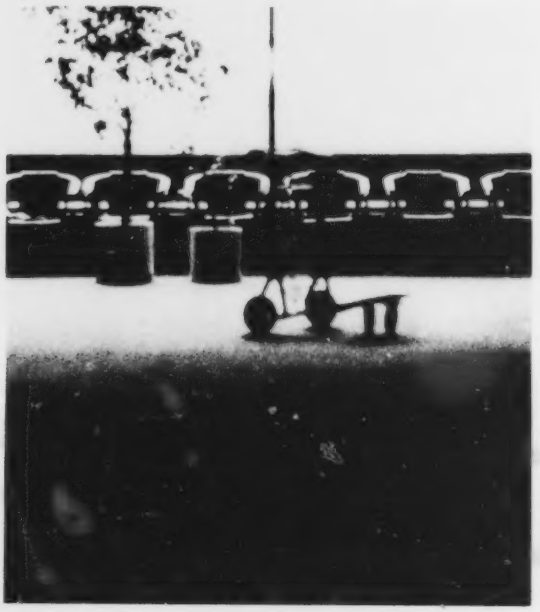
(i) Illumination levels must be adequate to enable the greatest number of visually impaired persons to utilize their vision effectively. The Illuminating Engineering Standards (IES) for transportation terminals should be followed.

(ii) Lights must be directed and controlled so that they do not create glare. A poorly placed sign can be made illegible by glare reflecting from its surface. The light source must be evenly distributed on the object or environment being viewed rather than being focussed directly into the viewer's eyes. (See Figure 8).

(iii) Matte finishes should be used in the environment in preference to highly-reflective, glare-promoting surfaces. These surfaces include highly polished furniture or flooring, shiny metals, glass and mirrored or ceramic-tile surfaces.

(a)

Portrays an escalator which has an excessive amount of glare from the glass dome at the top and very low illumination levels as it descends. This could present a major problem for someone who has light adaptation problems or problems with glare



(b)

Demonstrates how glare from the bright windows can conceal the luggage cart left in the middle of the circulation area

Figure 8 Examples of poor illumination

(iv) An environment should present a constant level of adequate illumination to pedestrians as they move from one part of the terminal to another. Illumination levels should be constant from one room to the next. On a bright day large windows which are not tinted or shielded can cause serious illumination level inconsistencies in a room.

(v) Particular attention should be given to areas such as elevators, stairs and landings which are often inadequately lit in comparison to the rooms opening onto them (26).

(vi) Use light to accentuate signage, stairs, handrails, and other decision-making points.

(vii) Use decor and colour to regulate and enhance the light available in a room. Most of the light that enters our eyes has not come directly from its source but has been reflected off the ceiling and walls and off objects in the room (26). Light-coloured decors reflect more light while dark-colour decors tend to absorb the light in a room.

5.5.2 Audition

Audition is especially important to a visually impaired person. When vision is not functioning, or not functioning well, hearing may provide some of the information about the environment usually received through vision. Hearing like sight is a long-distance sense which can tell an individual what is farther out in the environment. It helps to appreciate depth by identifying the existence of space and the distance through space to a sound reflecting surface or a sound emitting object. Hearing also enables comprehension of some of the characteristics of the environment. A person can learn to use reflected sound to determine whether a room is large or small and to infer the type of furnishings present (27).

Sound is a form of energy that travels through a medium — such as air — in a series of pressure waves. It is characterized by intensity, frequency and phase (28). In general, intensity is perceived as loudness and frequency is perceived as pitch. Phase can affect both the loudness and pitch of a received sound when sounds from a given source arrive at the listener's ear having travelled over different routes.

In order to make optimum use of the sounds in their environment, visually impaired people must be able to discriminate and identify sounds and localize the source of a sound. Once a sound is recognized

and localized, it can be utilized effectively to orient in an environment. Individuals may wish to walk towards the source; avoid it; or perhaps use it as an auditory landmark to orient themselves in their environment. Factors that may interfere with this process include: an environment which produces too high a level of echo reflection and ambient sound, sound shadows and the masking of sound.

High levels of echo reflection and ambient sound are commonly found in rooms which have poor acoustics; large empty rooms faced with materials that reflect sound efficiently. These rooms are said to present sound glare (29). Some such rooms reflect sound so well that it bounces and interferes with itself creating a room which is tiring to the listener.

Sound shadows and masking of useful sound also present problems to the visually impaired traveller. A sound shadow is a change in sound created when there is an object between a sound source and the perceiver (30). An example of this could be the visually impaired person trying to cross the street by effectively utilizing the sound of traffic flow patterns, however this time those sounds may be distorted or partially blocked by the presence of a large truck parked between the crossing position and the traffic sounds. Individuals must learn to recognize the presence of sound shadows so as to prevent them from interfering with critical sensory information.

The masking of sound occurs when one or more sounds interfere with the reception of, or blocks out, a desired sound (31). Crowds often mask or change sounds that normally emanate from a specific auditory landmark. For visually impaired people to be able to discriminate and identify sounds under masking noise conditions requires concentrated attention toward that which they want to hear. They must also tune out those auditory elements which are irrelevant for their purposes. Of course, sometimes the masking sound becomes so loud that no amount of attention or concentration will enable the blind person to hear the softer noise (32). A jet that roars overhead masking sounds of traffic flow patterns renders the visually impaired traveller temporarily immobile.

Typical auditory cues could be:

- the sound of a ventilator fan by which one could identify one's position in a particular hallway.

- the sound of children playing by which one could identify the location of a playground and thus verify one's location in the environment.

- the sound of an elevator door opening can be used to determine one's position by localizing the sound and determining position in relation to the elevator.

- the sound of traffic flow to provide information as to the safe direction to cross a street.

Visually impaired persons also rely on reflected sound and echo detection for travelling. The effective use of reflected sound to avoid obstacles is termed 'object perception'. Object perception is the process of determining the presence of an object in one's path by hearing reflected sound returning from the object. Echo detection or echo location is a related phenomenon that refers to detecting the presence or absence of a surface or object outside of one's path by utilizing reflected sound. Visually impaired persons gain much useful information for orientation and mobility by using the presence or absence of reflected sound.

Public address systems can become very important in relaying critical information to visually impaired persons. This is especially true in a setting where signage and print information are not provided in an accessible form for a visually impaired person. In order to be usable such address systems must provide high quality voice components that are clearly audible above the regular ambient noise level in the setting.

Recommendations

(i) Use carpets, acoustical tiles and furniture in moderation to reduce sound glare in a room without creating an acoustically dead environment. Some degree of sound reverberation is necessary to get the feel for a space; therefore the use of both carpets and acoustical ceiling tile in a moderately used corridor should be avoided.

(ii) Break down large areas into a succession of smaller areas which are more easily negotiated by a visually impaired person. Use a series of continuous sound producing beacons (water fountains, escalators, etc.) to create an overlapping guidance system of non-visual landmarks.

(iii) Screen noise sources to ensure that sounds intended to give directional guidance are not masked by undesirable noise emissions. Air conditioning units, electrical transformers or service entrances may mask the sounds intended to give directional guidance in a busy terminal. Sound cues are frequently taken from sounds emitted by elevators, escalators and exit doors (33).

(iv) A well designed aural environment strives to keep noise that is generated outside from entering an interior sound pattern; and to keep sound that is generated inside from bouncing around and creating undesirable background noise. Glass, unless it is double-spaced acoustic glass, is a particularly poor sound buffer and should be used with caution.

(v) Consider how your planned circulation paths will stand out when defined by a sound pattern energized by a tapping cane. Remember that recessed doors can be echo identified, different floor coverings reflect different sounds, and cross halls may be perceived by a sudden absence of reflected sound.

5.5.3 Touch

The sense of touch also serves as an important source of environmental information for a visually impaired person. For the totally blind person this source of sensory information is, in most situations, secondary only to audition. The visually impaired person with usable vision relies on the sense of touch to backup and confirm information received through vision and/or audition. For the deaf-blind person the sense of touch must play a primary role in providing environmental information.

Touch provides information to visually impaired persons about their immediate environment. The tactile quality of surfaces within a building can be designed to provide important information regarding orientation and directional cues. They can also be designed to provide consistent 'messages' such as information on emergency systems, or warnings regarding environmental changes, through the consistent use of a detectable warning surface. (See Figure 9.) Through the use of well designed orientation aids, such as tactile/large print maps, touch can also serve to provide some visually impaired persons with a means to assist with higher level comprehension of a complex spatial organization.

Touch is a general term. It refers to the study of both passive and active, cutaneous and kinesthetic experiences. Passive touch may be seen as involuntary i.e. a stimulus is imposed on a person's skin: whereas active touch is voluntary, directed and purposeful i.e. a person actively touches something else. In passive touch, the receptors in the skin and underlying tissue are stimulated. Active touch involves the voluntary exploratory and manipulative use of the skin, and hence stimulation of receptor systems in the muscles, tendons, and joints — the kinesthetic system (34).

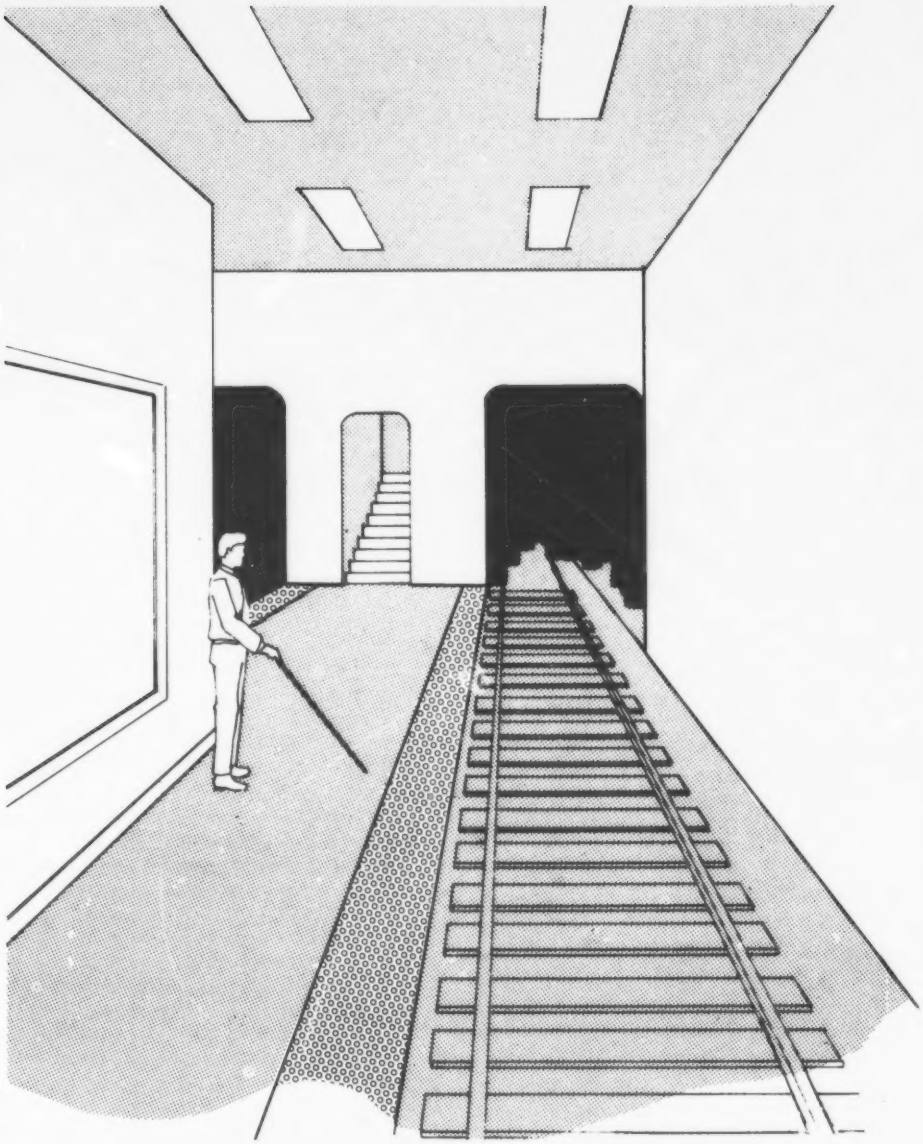
For the purposes of this manual the more passive experience of touch is described as 'tactual perception'; the more active experience of touch is described as 'haptic perception' (35). Controversy still exists in the literature regarding which experience provides the user with the more superior form of information.

It is important to understand some of the functional characteristics of touch that differentiate it from other sensory systems, and to recognize how a visually impaired person might use these characteristics in travel situations.

Unlike the visual system, the system of touch provides environmental information in a much more serial and fragmented manner. While the amount of fragmentation, depends to some degree on the tactual exploration skills exhibited by the visually impaired person, the manner in which information is processed from the sense of touch ensures that a certain degree of fragmentation and serial presentation is inevitable.

For example, a sighted person can visually scan a room and immediately receive simultaneously presented visual feedback that helps the individual form an integrated mental picture of the spatial relations of objects in the room. The same room can be explored haptically by a visually impaired person who has very limited vision, or no vision. To independently gain familiarity with this same space the individual must physically explore the space piece by piece. The individual may choose to trail the perimeter identifying objects, and then move in a gridwork fashion across the interior of the room.

The result is that for the visually impaired person the information received is gained much more slowly and is presented in a piecemeal manner. The person then must be able to cognitively remember the locations of objects in the room and pull the pieces together to reasonably determine how one object in the room spatially relates to another object in the room. Simple straightforward design elements, incorporat-



The detectable warning surface should be positioned parallel to the open platform edge. It should extend for the full length of the platform; and it should maintain a depth of 61 cm from the open edge of the platform

Figure 9 Proposed detectable warning surface on an elevated platform

ing good wayfinding elements and right-angle configurations, can greatly assist in formulating a clear mental picture of the space.

What may appear simple and straightforward to the visual system, may seem complex and difficult to discriminate and identify through the sense of touch alone. With the exception of the discrimination of some textures, the sense of touch can not process the same type of stimulus and degree of complexity as the visual system. This is very evident in reviewing the usability of some of the current tactile display boards and maps which have been developed based primarily on sighted aesthetics. The content and figure-ground presentations of such aids often present a sense of clutter and information overload to the tactual reader. There are principles of design given in the literature that should govern the development of tactile graphic aids. Such aids should be developed through the assistance of a local consultation team that is well aware of these principles so as to ensure maximum legibility for most users. Information that is being provided in the travel environment must be clearly discriminable and detectable through the sense of touch.

In order to prevent adaptation from occurring, touch should be light and constant. The role of movement differs considerably for vision and touch. In vision, movement may impede perception of surface qualities, but in touch, it is lack of movement that is most damaging. The touch organ, when kept motionless relative to the object, is beset with a partial anesthesia. Movement is as indispensable to touch as light is to vision (36). When providing tactual cues, such as detectable floor or wall surfaces, to a visually impaired traveller it is important to ensure that the detectable surface extends in sufficient dimension to allow a visually impaired traveller adequate time to sense the surface and react to it while moving across the surface.

In order to enable the visually impaired traveller to utilize the sense of touch most effectively to gain information in the travel environment, the designer must be aware of effective haptic exploration techniques. Visually impaired individuals who have lost their vision later in life may be able to explore their environment very effectively by using the sense of touch. However, some congenitally, visually impaired persons may not have developed good manual dexterity skills due to lack of opportunity for visual imitation and modelling, or delays in early motor development. The inability to utilize effective haptic exploration techniques limits the amount and complexity of information these individuals can receive through the sense of touch.

Some visually impaired persons have medical conditions that may impinge on the ability to discern information through their sense of touch. Individuals with diabetes or other circulatory problems may experience a lessened sensitivity in their peripheral extremities. A natural process of aging results in lessened sensitivity for some elderly persons. For some individuals even calluses on the fingers can result in less information being received through the fingertips. Individuals who have experienced stroke or other neurological injury may, depending upon where the injury is in the brain, experience problems with receiving and processing information from their sensory systems.

As for other sensory systems discussed in this manual, it is important always to consider pairing sensory information. This could mean not only providing a detectable warning surface that is tactually discriminable, but also utilizing a surface that will provide a difference in audition and visual cues from its surrounding surface.

Recommendations

(i) The sense of touch presents information in a serial and fragmented form when compared to vision. To assist with the understanding of spatial relations in a setting, the design should follow wayfinding principles and utilize simple, right-angle configurations for room layout.

(ii) Tactile cues such as detectable floor or wall surfaces should be of sufficient dimension to allow a visually impaired person adequate time to sense and react to the surface while moving through the terminal.

(iii) Tactile cues utilized for warning surfaces must be clearly differentiated from other surfaces in the setting and must be located consistently throughout the setting. Installation must occur in one time period throughout the setting. The tactile warning surface must be clearly detectable under both foot and cane.

(iv) Tactile/low vision graphic maps should be made available to visually impaired persons. These should be portable and be designed for optimum usability. Their development should follow established guidelines in the literature and be undertaken through input from the local consultation team.

(v) Tactual orientation cues should be presented in the environment paired with other sensory information. The walls leading

into a specific wing of a building might not only feel different to the sense of touch, they might also be painted a different colour and provide a different sound quality.

(vi) Extremely uneven, rough or sharp surfaces should not be utilized for wall surfaces. These surfaces are unpleasant to the sense of touch and can interfere with any necessary trailing of the surface.

5.6 WAYFINDING

The recommendations and descriptions of how visually impaired persons travel given thus far have been developed by visually impaired persons and persons working closely with them. The techniques and methodologies we have mentioned make it possible for a visually impaired person to travel independently in a less than friendly environment.

Recently a growing understanding has emerged among designers, builders and building operators of the travel concerns experienced by visually impaired persons. As a result, a design science called 'wayfinding' is receiving increased attention.

A wayfinding system for any terminal environment encompasses environmental communication, destinations, routes, reference points, tenants' input and — in deference to the newness of the science — experimentation/implementation and evaluation. You will see that the wayfinding components recast the concerns of the visually impaired traveller into a logic that can be addressed by terminal developers.

(a) Environmental Communication is the wayfinding term for sensory information. Four categories are used: visual, tactual, audition, and combinations of the first three categories.

(b) Destinations include an array of points that are defined by answering the question: "Where does the person entering the terminal wish to go within the terminal building?" This aspect of the wayfinding system assists building planners to develop routes and reference points that will be understood easily by visually impaired persons.

(c) Wayfinding routes ideally have few obstacles and no hazards. They are defined by the shorelines and environmental cues of

the wayfinding system. They are as direct as possible between important locations e.g. check-in counters and departures gates, or arrival gates and ground transportation pick-up points. Most importantly they are designed so that a visually impaired traveller can move over them with confidence, knowledge and safety.

(d) Wayfinding reference points are made available at all decision making points along terminal routes. Signage, public address, and structures described on terminal maps are all used to assist the visually impaired traveller in deciding on the appropriate direction of travel. A good wayfinding system often uses more that one reference point to carry a specific decision making message.

(e) Tenants' input to a terminal wayfinding system is sought because the nature of the concession — restaurant, lounge, hotel — creates an overlay of travel patterns on the routes and destinations selected solely for travel purposes. Additionally, high ambient noise could mask some of the environmental cues of the wayfinding system. This interference could result in confusion for the traveller and in lost business for the concessionaire. To forestall this circumstance, the concessionaires are involved in the planning stages of the building wayfinding system design.

(f) Because wayfinding science is in its infancy, some experimentation with the design is expected. During the design stages consumer groups, tenants' groups and terminal operators are consulted. Even so the system is tested after it is in place and frequently minor changes must be implemented.

Appendix H describes wayfinding systems that could adequately meet the needs of visually impaired travellers in transportation terminals. To elaborate on how the travellers concerned could use such a system, two examples of travel problem-solving are given in the Appendix.

SPECIFIC DESIGN RECOMMENDATIONS

6

6.1 GENERAL

The general principles of design discussed in Part 5 are reinforced in the specific remarks found in this Part. The current Canadian standards do not deal with visual impairment and access issues in sufficient depth. The information in this Part is meant to supplement existing accessibility standards with regard to access for visually impaired persons. The recommendations deal specifically with visual impairment and access issues and do not address accessibility needs specific to other disability groups. Therefore, they must also be applied in conjunction with the broader existing standards and recommendations that have been developed for all disabled persons.

The recommendations listed below should be used in conjunction with the guidelines cited in the British Columbia Building Code, Section 3.7, except where differences and additions are noted. Where information is quoted from another building code or standard, that source is identified.

6.2 INTERIOR

6.2.1 Entrances

(a) Entrances should be situated centrally and in such a way that they are easy to find. In order that they may be seen from a distance, they should be colour/brightness contrasted from the surrounding area. Appropriate signage (see 6.2.7) should clearly designate the building entrance. Accessible building entrances should lead to a main lobby or main corridor.

(b) Main entrances should connect with public transportation stops, accessible parking, passenger loading zones and/or public streets or sidewalks. The entrance should be approachable by a safe pedestrian walkway. Access routes to the building entrance from public transportation stops should not require travellers to cross a parking lot, nor behind parked cars.

(c) Information desks, signs, etc., must be consistently placed and readily locatable.

(d) Entry doors should comply with recommendations of 6.2.13. There should be no step up or down immediately on either side of an entry door.

(e) Entrance ways should be illuminated with transitional illumination. In the case of a glass exterior door, the exterior light should be diffused and attenuated by means of light diffusing materials (37). Visually impaired persons frequently experience light adaptation concerns, especially if a dark corridor leads to a brightly illuminated exterior door; a plate glass door on a bright sunny day, for example.

6.2.2 Lobbies/Open Areas

(a) Where possible large open areas should be divided into smaller, regular right-angled spaces. This can be done through the effective use of: acoustical ceiling and wall treatments, detectable floor textural differences, and landscaping and furniture arrangement. All landscaping and furniture treatments should be out of main travel passageways and should comply with clearance dimensions cited in 6.2.3.

(b) Large open areas which have functional, main circulation routes should define these routes with detectable, floor surfaces. These surfaces should be differentiated from the surrounding flooring by use of one or more of the following: colour/brightness contrast, auditory cues, resiliency, and/or texture. The surfaces should feature a matte, non-glare finish. One example of this differentiation is light-coloured vinyl flooring utilized for the main circulation route in a lobby otherwise covered with dark carpeting. Textured surfaces used throughout a building must be consistent and be clearly distinguishable from detectable warning surfaces described in 6.2.5.

(c) All queue areas should be clearly designated. They should be located so that queues do not obstruct main circulation routes.

6.2.3 Passageways

(a) Clearance dimensions for all interior travel passageways should be as follows:

minimum overhead clearance	1980 mm;
minimum clearance width	1500 mm.

Side protrusions shall not reduce the minimum clearance width. Anything that protrudes more than 100 mm from a passageway wall must have leading edges mounted at or below 650 mm above the

finished floor. (See Appendix I.) Where possible, wall mounted objects should be recessed rather than projected.

These recommended dimensions are based on the long-cane travel-clearance dimensions. However, many low-vision people may rely on their residual vision rather than on a cane. For these individuals any protrusions, even those less than 100 mm, may pose a travel concern. Therefore, it is preferable that there not be any projections into travel passageways. If projections of less than 100 mm are unavoidable, they should be colour/brightness contrasted so as to be more visually discernible for some low-vision travellers.

(b) All stairs opening into a passageway must be preceded by the detectable warning surface described in 6.2.5. It is preferable that vertical level changes (i.e. stairs or ramps) be located out of the direct walkway or corridor route.

6.2.4 Emergency Exits/Alarm Systems

(a) The decibel rating for ease of recognition of audible alarms by visually impaired persons who do not have a hearing impairment is 90-98 decibels at 3 metres (38). However, in order to alert individuals properly, the audible emergency alarms should produce a sound that exceeds by 15 decibels the equivalent ambient sound level in the area, or exceeds by 5 decibels any maximum sound level with a duration of 30 seconds, whichever is louder. The alarm shall in no case exceed 120 decibels (39). The alarm should be intermittent in order to assist with sound localization and to allow individuals to utilize other auditory cues that may be present.

The alarm needs to be loud enough to alert the visually impaired person to an emergency situation and, at the same time, not be excessively loud so as to disorient and mask other audible cues used for orientation and egress.

(b) The placement of an alarm must be such that visually impaired persons can localize the sound through audible and visual cues, and effectively navigate the route to the emergency exit door. Therefore the alarm, audible-signal appliance should be placed immediately above the emergency exit door. Because in large buildings more audible-signal appliances than exit doors would likely exist, the additional appliances should be located so that they form an audible pathway to the emergency exit door. The appliances could be placed in the ceilings of corridors, foyers, rooms, etc. if an exit door did not exist within the immediate vicinity.

(c) All signage on the emergency exit door should comply with 6.2.7.

(d) In order to assist with egress, staff should be well trained in emergency procedures and the emergency escape routes could be clearly indicated on relevant orientation aids as described in 6.2.8. These aids, tactile/large print maps and/or audio maps, could be made available at information booth/check-in counters. All such maps should clearly indicate emergency exit routes and provide information concerning egress during an emergency.

(e) A clear and accessible approach to an emergency exit is vital for the visually impaired person. Therefore, all exit routes must comply with the clearance dimensions for safe unobstructed travel given in 6.2.3 (a).

(f) All illumination should comply with the recommendations given in 5.5.1 (b). To assist with adaptation concerns, the lighting level should be consistent within 50 metres of the exit door. This is especially important for effective night-time egress.

(g) In order to facilitate identification by visually impaired persons, the exit door should be painted in a colour/brightness contrast from the surrounding wall. The colour for emergency exit doors should be consistent throughout the building and different from other door colours in the building.

(h) The visually impaired person not only must locate the exit route/doorway after hearing the alarm but also be able to exit the doorway safely. A clear path (see 6.2.3 (a)) of 50 metres beyond the doorway is desirable. Should there be any barriers or obstacles within the path of travel, colour/brightness contrast and lighting cues should be used. The area immediately beyond the doorway should not have any sudden elevation changes, e.g. steps. All stairs must be properly marked by the detectable warning surface as outlined in 6.2.5.

6.2.5 Detectable Warning Surfaces

Based on research conducted to date, the chacteristics of the detectable warning surface material outlined in Appendix J appear most promising (36). However, while this material has been thoroughly researched regarding usage at elevated subway platforms, further documented research is required before it could be recommended for usage at curb cuts and stairways. It is important that all research be completed in this area prior to installation at any of the settings outlined in

6.2.5(d). The findings of such research will define the warning surface chacteristics to ensure that a uniform warning message is presented to visually impaired travellers. The selected surface should be installed throughout a building as far as possible in a single application rather than being installed piecemeal over a period of time.

(a) The detectable warning surface must be easily detected by visually impaired persons who may be utilizing one or more of a wide variety of mobility systems, e.g. residual vision, the long cane, guide dog. Therefore the surface must be able to provide cues for each individual's travel mode. The detectable warning surface must consistently present detectable differences in resiliency, texture, colour/brightness contrast, and audition in order to be discernible to a maximum number of visually impaired persons. The textural difference must be of such a degree that it can be easily detected under foot or under the long cane tip.

(b) All detectable warning surfaces in a building must be consistent in: placement, materials utilized, and the warning message they convey to visually impaired persons.

(c) There should not be any flooring material utilized in a building which could be confused with the detectable warning surface.

(d) It is recommended that the detectable warning surface only be utilized at stairs (6.2.16 and 6.3.5), elevated platforms (6.2.18), and curb cuts (6.3.4).

6.2.6 Building Hardware/Furnishings

(a) All building hardware and furnishings in travel paths should meet requirements outlined in 6.2.3 (a). Necessary wall mounted equipment should be recessed into the wall rather than projected from the wall surface.

(b) All furniture should be of colour/brightness contrast to its surrounding area. It is preferable that furniture be of a design that minimizes sharp uncovered corners. Furniture should be positioned out of the main walkway area.

(c) Furnishings and equipment should be of a low, light-reflective nature in order to minimize glare. Furnishings and equipment, such as taps, light switches, or paper-towel dispensers, should be consistently positioned throughout the building and should be of standard design and colour so they are easy to locate and recognize through touch.

(d) Where public telephones are equipped with cane detectable side panels, it is preferable that these panels be colour/brightness contrasted with surrounding surfaces and not be of a clear material. Telephone controls and directions for use should have an illumination level of at least 50 foot-candles. Telephones should have push button controls where service for such equipment is available.

6.2.7 Signage/Symbols

(a) The need for general orientation signage should be minimized by effective use of wayfinding and orientation principles in the building design.

(b) All signage should be consistently placed and of uniform design so as to be easily located and accessed.

(i) All signage should have characters with a stroke width-to-height ratio between 1:6 and 1:10, utilizing an upper case "X" for measurement, and a character width-to-height ratio between 3:5 and 1:1. (Use an upper case 'X' for measurement). Only Arabic numerals and sans-serif upper case letters should be used.

(ii) All signage should have a glare-free matte surface. The colour/brightness contrast between the character colour and the background colour should be at least 70 percent based on the formula:

$$\text{Contrast} = \frac{B1 - B2 \times 100}{B1}$$

Where B1 = reflectance of brighter area
B2 = reflectance of darker area

It is preferable that light characters on dark backgrounds be utilized (14). It is preferable that the sign background also be colour/brightness contrasted to the surrounding surface area.

(iii) Illumination for signage must be shadow and glare free and in compliance with recommendations outlined in 5.5.1 (a). Illumination for the sign panel itself should be a minimum of 10 foot candles (19).

(iv) The size and intended viewing distance of general orientation and specific information signage should comply with the table below.

Dimensions for Print Height and Distance on Signage

Minimum Print Size	Maximum Viewing Distance	Use of Information
203 mm	610 cm	Station Entrances
152 mm	457 cm	Station Name, line name (from train and from station entrance)
100 mm	254 cm	Train name (viewed from platform)
76 mm	228 cm	Line transfer information inside station
51 mm	152 cm	Route information on display maps
25 mm	76 cm	Doors/rooms

Information is taken in part from Reference (3).

(v) Signage for general information and orientation should be consistently placed at key decision making points. It should be located well above head level in heavy pedestrian traffic areas so as to increase visibility in crowded conditions. The clearance dimensions cited in 6.2.3 shall apply.

(vi) Doors and openings that lead from public places, and through which the public is permitted to pass, shall be identified by specific tactile information signage. Markings should be in sans-serif, upper case characters and/or Arabic numerals raised 1 mm with a high, stroke width-to-height ratio to facilitate reading by touch. Letters or numbers shall be at least 16 mm high but no higher than 51 mm.

(vii) It is preferable that placement of signage for doors be on the wall to the right of the door. Signage should be consistently located 1350 mm +/- 3 mm above the finished floor and not more than 150 mm from the door jamb.

(viii) Enclosed stairwells shall have specific information signage to designate each floor. Such signage shall consist of Arabic numerals indicating the floor number and shall be permanently mounted on the stairway side of the wall, preferably to the right of the door. Placement dimensions for this signage

should be consistent with 6.2.7(b)(vii); Signage dimensions should be consistent with 6.2.7(b)(vi).

(ix) Symbols and pictograms should be supplemented with print information.

(c) Large print materials should be presented in 18 point sans serif type. (National Association for the Visually Handicapped, Large Print Standards). It is preferable that light characters on dark backgrounds be used.

(d) Braille signage should be presented in grade 2 braille with a format and code that meets the Standards outlined by the Braille Association of North America.

(e) Information Signage should not be of the video display format where the information is rapidly scrolled across the video monitor screen. This type of signage usually changes messages so frequently that most low-vision travellers would encounter difficulties in attempting to visually fixate on the words long enough to read the signage.

6.2.8 Orientation Aids

(a) Where there is not a staffed information desk near each accessible main entrance, there should be an information telephone placed adjacent to the entrance. The telephone should be staffed by informed personnel who can provide appropriate orientation or other general information assistance to visually impaired persons and other travellers in need of assistance. The telephone should be in a consistent location throughout the setting and be of a consistent colour which is colour/brightness contrasted from the surrounding area.

(b) It is preferable that copies of portable maps be made available to visually impaired travellers in both the tactile/large print mode and the audio mode. In order to ensure usability these maps should conform to design principles outlined in the literature and be designed using input of the local consultation team.

6.2.9 Information Access

The wayfinding principles and the accessible design features incorporating appropriate sensory cues should be implemented in all terminal settings. By doing this, visually impaired individuals will be consistently afforded access to information necessary for orientation purposes.

(a) All relevant signage and print materials should meet recommendations outlined in 6.2.7.

(b) Where monitors are present to provide travel information e.g. arrivals, departures, there should also be present at least one monitor equipped with a non-glare screen that is located 1350 mm +/- 3 mm above the finished floor surface. This monitor should be located in such a manner that visually impaired print users can position themselves within a few inches of the screen in order to read the print if necessary. The screen should be a high resolution type and the system should provide for black-on-white or white-on-black images (reverse polarity). It is preferable that the monitor also be equipped with speech and large print access. Placement and location of such monitors should be consistent throughout the setting.

(c) Public address systems should be of a sound quality that is clearly discernible above ambient noise in the setting.

(d) Emergency information available in print should be made available in large print, audio tape and braille. It is preferable that other general information such as schedules, fare and gate information also be made available in these modes, particularly if such information is not available in advance via telephone.

(e) Where staffed information desks are not immediately adjacent to main accessible entrances, it is preferable that there be an information telephone system staffed by trained and informed personnel set up in a consistent location adjacent to the main accessible entrances.

(f) It is preferable that orientation aids as recommended in 6.2.8 be made available.

(g) It is preferable that a CCTV system to assist low-vision individuals with access to print material be made available at the main information access points.

(h) One of the most important elements for ensuring information access by visually impaired persons is the presence of trained, knowledgeable and caring service personnel who are readily available to offer reasonable assistance upon request.

6.2.10 Queuing/Line-ups

(a) All queue areas should be clearly designated. They should be located so that queues do not obstruct main circulation routes.

(b) It is preferable that suspended queue guides not be utilized. Where they are in existence, they should meet all cane clearance dimensions outlined in 6.2.3 (a), and be in colour/brightness contrast to the surrounding flooring.

6.2.11 Counters

(a) Counter surfaces should be cane detectable and colour/brightness contrasted from the surrounding surface.

(b) Counter surfaces should have a non-glare, matte finish.

(c) Where a glass partition separates customers from service personnel, there should be an adequate speaker system in place to facilitate verbal communication between both parties and to assist a visually impaired person to localize the origin of the speaker's voice.

6.2.12 Floors

(a) Floor surfaces should have a non-glare, matte finish.

(b) The floor surface in large open areas should provide orientation cues for main circulation routes by differing in resiliency, colour/brightness contrast, texture and audition, 6.2.2.

(c) To avoid possible figure ground and depth perception difficulties, it is preferable that the use of heavily patterned floor surfaces be minimized especially in areas where there are elevation changes, 6.2.16.

6.2.13 Doors

(a) Doors to hazardous rooms should incorporate appropriate warning signage in compliance with 6.2.7 and should be kept locked.

(b) There should not be any rough texture, such as knurling, applied to door handles. At present there is conflict in the guidelines concerning textured door handles; hence, there is potential for dangerous misinformation to visually impaired persons.

NOTE: Contradictions are present in existing building codes and standards regarding the roughening of door handles. The British Columbia Building code section 3.7 and The American-National Standard for Buildings and Facilities (ANSI) contradict one another regarding the application of a rough texture on door handles. The B.C. Building Code Section 3.7 recommends the texturing of door handles to indicate the buildings exit facilities. The ANSI standard recommends the texturing of door handles to warn of a hazardous area.

(c) Where double doors are used, in order to assist access by guide dog users, it is preferable that both door leafs be unlocked and functioning during operating hours.

(d) Doors should be installed so that they open with the main flow of pedestrian traffic and do not open outwards into busy passageways. When closing, swing doors should not swing beyond the normally closed position.

(e) It is preferable that automatic doors slide open parallel with the wall rather than swing open toward or away from the pedestrian line-of-travel.

(f) Doors and door frames should be colour/brightness contrasted from their surrounding surfaces. Door handles should be colour/brightness contrasted from the door surface.

(g) Automatic entry/exits that employ a door which swings toward or away from the pedestrian line-of-travel should have: guard rails, power floor mats extending for the full swing area of the door, horizontal or vertical sensing devices and doors that remain fully open until area is cleared by the user.

(h) Signage for doors should comply with the recommendations in 6.2.7.

(i) In doorways where thresholds are not flush with the floor, the difference in level shall not exceed 13 mm and shall be beveled. The elevated area should be colour/brightness contrasted from its surrounding surface.

(j) It is preferable that doors not be completely made of glass. Where such doors currently exist they should have colour/brightness contrasted markings, a minimum of 130 mm in width, applied horizontally across the full door surface 1350 mm +/- 3 mm above the finished floor.

(k) It is preferable that doors be equipped with self-closing devices, particularly in the case of doors opening into busy pedestrian circulation routes. When left open, a door should be flush against a wall rather than partially open.

(l) Automatic revolving doors should not be used. The design of such doors makes them very difficult for a visually impaired person to detect in some cases. The doors themselves can prove to be a hazard to a visually impaired traveller.

6.2.14 Windows/Skylights

(a) All windows and skylights should meet with recommendations outlined in 5.5.1.

(b) Windows and skylights are natural illumination sources which can be hard to direct and control. They should be carefully designed and adapted so they do not create glare problems for visually impaired individuals.

(c) The amount of natural light entering a window or skylight should be controlled. A more consistent presentation of natural light can be ensured through such means as: the location of window, the use of diffusers and/or tints, and the use of awnings. Backup lighting should be used for night and dark day illumination.

(d) All windows should be designed so that they meet recommendations for clearance dimensions as outlined in 6.2.3.

(e) It is preferable that there not be large expanses of interior windows utilized to divide rooms or serve as general partitions. Where these are in existence they should have colour/brightness contrasted markings, a minimum of 130 mm in width, applied horizontally across the full window surface 1350 mm +/- 3 mm above the finished floor.

6.2.15 Walls

(a) All wall surfaces and fixtures should meet recommendations for clearance dimensions outlined in 6.2.3.

(b) Different wall colour schemes paired with textural surfaces may be used consistently throughout a setting to signify specific areas within the terminal, e.g. exit routes, entrances for concessions, restaurants, cafeterias, washrooms. These consistent visual and tactile cues can assist a visually impaired individual with orientation.

(c) Materials utilized in the design of walls should take in to consideration the acoustical requirements of the setting. Design of walls should follow recommendations outlined in 5.5.2.

(d) Wall and floor surfaces should be colour/brightness contrasted from one another.

(e) It is preferable that wall surfaces not be designed entirely of mirrored or glass surfaces. Where these are in existence they should have colour/brightness contrasted markings, a minimum of 130 mm in width applied horizontally across the full wall surface 1350 mm +/- 3 mm above the finished floor.

(f) It is preferable that walls have a matte finish and that they not have extremely rough or uneven surface qualities which could be uncomfortable to touch.

6.2.16 Stairs

(a) The approach to a stairway is very important to visually impaired travellers. The stairway should not be in an unexpected location. All stairways should be consistently positioned and clearly marked with a detectable warning surface. It is preferable that stairs be located out of direct pedestrian circulation routes.

(b) The onset of all stairs, whether enclosed or in open areas, should be preceded by a consistent, detectable warning-surface; see 6.2.5. Pending further research validation it is proposed that the detectable warning surface extend the full width of the stair, maintain a depth of 762 mm and commence one tread depth back from the front edge of the stair. Where there are flights of stairs the detectable warning surface shall be present at the commencement of each stair flight that has a pedestrian entrance.

(c) When retrofitting existing buildings it is preferable that the installation of detectable warning surfaces occur on all stairs as nearly as possible within the same time period for a given building. Installations should not be made piecemeal because of the risk of creating confusion for visually impaired travellers.

(d) In order to allow for adequate warning to visually impaired travellers where a doorway opens to a stairway, the stairway should be preceded by a level area of at least the same dimensions as a standard stairway landing.

(e) All stair risers must be of consistent dimension and design throughout a stair system and preferably throughout a building complex. Risers shall be a maximum of 180 mm in height and be sloped or provided with a nosing, the underside of which has an angle of not less than 60 degrees from the horizontal (39).

(f) Stair treads should be of a uniform and consistent depth, not less than 280 mm and not more than 355 mm including the dimension of the nosing. Stair treads must have a uniform depth throughout a stair system and preferably throughout a building complex. Stair treads should be finished with a slip-resistant, glare-free matte surface.

(g) There is no need to project stair-tread nosings on stairs that have proper tread depth. Where used, stair-tread nosings should project no more than 25 mm beyond the associated risers and should extend horizontally onto the tread surface a minimum of 25 mm. The nosings should extend vertically no more than 1 mm above the tread or landing surface. The nosings should be constructed of a slip-resistant surface (not smoothly finished metal, plastic, wood, etc.). Nosings, or where nosings are not used the leading horizontal surface of each tread, should incorporate a colour/brightness contrast factor with the associated riser and tread. They should be clearly visible from the top and bottom of stairways. Nosings should not incorporate sharp design configurations either on the top of the tread surface or the underside and should have a radius of curvature at the leading edge of the tread of not more than 12 mm. The tread surface should be of a dark colour with a lighter colour utilized for the nosing.

(h) Carpeted stairs should incorporate slip-resistant, colour/brightness-contrasted nosings. Only tight-weave, low-pile carpeting should be used on stairs. It should be firmly attached and be kept in good repair. It is preferable that heavily patterned carpet designs, especially designs incorporating stripes, not be utilized on stairs. Such designs can cause figure-ground concerns for the low-vision traveller thus interfering with the visual identification of the tread nosing and creating undue difficulties with depth-perception judgments. Remember, figure ground confusion can arise from any heavily patterned surface, e.g. terrazzo, stone.

(i) Landings should be of standard width. It is preferable that doorways opening onto landings be located consistently on the wall opposite to the open stairway. This placement assists with enabling a visually impaired person to approach the stairway at a 90-degree angle.

(j) All stairways should incorporate closed stringers.

(k) It is preferable that handrails exist on both sides of the stairway. In order to meet clearance dimensions for cane detectability, the ends of the handrail should return smoothly to the wall or floor. All handrails should be colour/brightness contrasted from their surrounding surfaces.

(l) Hand rails to stairs shall extend at the top to a minimum of 300 mm beyond the top riser parallel to the floor or ground surface; and at the bottom continue to slope one tread depth beyond the bottom tread and then a further 300 mm horizontally beyond, except where the handrail is continuous.

(m) Handrails should be graspable along their entire length. The thumb and fingers should be able to curl around and under the handrail to achieve a secure grip. For adults, this requires a circular, oval or rectangular section with maximum dimensions in the horizontal orientation. This dimension should be less than 50 mm, preferably 35 mm.

(n) Where ramps and stairs are located adjacent to one another, there should be at least a handrail clearly dividing the two structures. The presence of the handrail prevents a visually impaired person from accidentally stepping off the side of the stairway onto the ramp.

(o) The illumination level in stairway areas should be glare free and consistent with the illumination level in the remainder of the building, (see 5.5.1(a)). Due to the critical nature of stairs, they should be provided with alternative emergency lighting so that if the main source of lighting fails a second source will continue to provide light (41).

(p) Landings, treads, and nosings shall be stable, firm, slip-resistant and free of debris that could present a tripping hazard.

(q) Winding and spiral staircases constructed with tread surfaces that vary in width are not recommended.

(r) The use of free-standing or cantilevered staircases should be avoided. Such designs present a non-cane detectable hazard to visually impaired travellers. The undersides of such stairways should be enclosed through original design or by the placement of cane-detectable landscaping or furnishings to prevent access to the overhang area.

(s) All signage to designate floors in enclosed stairwells shall comply with recommendations in 6.2.7.

6.2.17 Ramps

(a) Handrails for ramps should be consistent with handrails outlined for stairs, 6.2.16.

(b) Where ramps and stairs are located adjacent to one another, there should be at least a handrail clearly dividing the two structures. The presence of the handrail prevents a visually impaired person from accidentally stepping off the side of the stairway onto the ramp.

(c) It is preferable that ramp surfaces have a colour/brightness contrast factor a well as a tactile surface difference from the surrounding area.

(d) The illumination level for ramps should meet recommendations outlined in 5.5.1. Ramps should have alternative emergency lighting so that if the main source of lighting fails a second source will continue to provide light.

6.2.18 Elevated Platforms

(a) Illumination for areas with elevated platforms should meet with recommendations outlined in 5.5.1.

(b) Elevated platform edges should be marked with detectable warning surface material as outlined in 6.2.5.

(c) The detectable warning surface should be positioned parallel to the open platform edge. It should extend for the full length of the platform; and it should maintain a depth of 61 cm flush from the open edge of the platform.

(d) The detectable warning surface utilized should be consistent in material and placement throughout the setting.

(e) When retrofitting existing buildings it is preferable that the installation of detectable warning surfaces occur on all open platforms as nearly as possible within the same time period for a given building. Installations should not be made piecemeal because of the risk of creating confusion for visually impaired travellers.

(f) All parts of the elevated platform that are accessible by travellers must meet recommendations for clearance dimensions as outlined in 6.2.3.

6.2.19 Escalators

(a) The back of all escalators should be enclosed. Escalators with open backs present a non-cane detectable hazard to visually impaired travellers. The back of the escalators can be enclosed through original design or by placement of fixed cane-detectable landscaping or furnishings to prevent access to the overhang area.

(b) Escalator platforms should extend a minimum of 600 mm from the onset of the escalator in order to provide adequate warning of its presence to visually impaired persons.

(c) Escalators should have general information signage indicating their presence and their direction of travel. All signage should comply with 6.2.7.

(d) Escalators under repair should have signage indicating that they are out of order. The landings for the escalator should have an appropriate barricade (see 6.2.25) to prevent public access.

(e) The escalator tread should be painted a minimum of 25 mm from the escalator step edge with a coating that incorporates a colour/brightness contrast from the surrounding tread surface. Where escalators may reverse direction of travel, both the tread and the riser should be painted a minimum of 25 mm from the escalator step edge.

(f) Illumination for the escalator and surrounding area should comply with 5.5.1.

(g) It is preferable that the escalator surface be constructed of low-reflective, non-glare material with a matte finish.

(h) It is preferable that a stairway or other means of vertical access be positioned next to the escalator to assist those guide dog users who have not trained their guide dog to access escalators.

6.2.20 Moving Walkways

(a) The back of all inclined, moving walkways should be enclosed. Walkways with open backs present a non-cane detectable hazard to visually impaired travellers. The back of the walkways can be enclosed through original design or by placement of fixed cane-detectable landscaping or furnishings to prevent access to the overhang area.

(b) Walkway platforms should extend a minimum of 61 cm from the onset of the walkway in order to provide adequate warning of its presence to visually impaired persons.

(c) Walkways should have general information signage indicating their presence and their direction of travel. All signage should comply with 6.2.7.

(d) Walkways under repair should have signage indicating that they are out of order. Entrances and exits of walkways should have an appropriate barricade to prevent public access. (See 6.2.25)

(e) There should be a minimum 25 mm width marking, colour/brightness contrasted from the surrounding area located across the full width of the platform edge to indicate the onset and exit of the moving walkway surface.

(f) Illumination for the walkway and surrounding area should comply with 5.5.1.

(g) It is preferable that the walkway surface be constructed of low reflective, non-glare material with a matte finish.

6.2.21 Elevators (See Figure 10)

(a) The elevator car operating panel shall be marked with tactual markings immediately to the left of the car control buttons. Markings should be symbols and/or Arabic numerals or sans-serif letters. The markings should be colour/brightness contrasted to their background surface. As some congenitally blind persons do not know print letters or Arabic numerals, it is preferable that elevator control buttons be marked with braille as well. It is preferable that the braille be positioned to the left of the raised symbol, numeral or letter. All raised markings and other signage should be in compliance with dimensions outlined in 6.2.7.

(b) Control buttons such as door open, door close, emergency controls, and other essential identifications should be located below floor number controls. There should be a star symbol to the left of the main entry floor button.

(c) Heat sensitive control buttons should not be used on the elevator car operating panel.

(d) Floor designations at each hoistway entrance on each jamb should be indicated by tactile Arabic Numerals and/or upper case sans serif letters. Markings should be a minimum 38 mm high, raised 1 mm, and centered 1524 mm above the finished floor.

(e) The elevator car operating panel should be equipped with floor registration buttons that visually register each call and extinguish when the call is answered. Buttons should have a minimum dimension of 19 mm, and be raised, flush, or recessed with depth of flush or recessed buttons, when operated, not to exceed 9 mm (42).

(f) The elevator car should be equipped with a visual car position indicator to show the position of the car in the hoistway by illumination of a marking corresponding to the landing at which the car is stopped or passing. The indicator should use minimum 16 mm high characters on a colour/brightness contrasted background.

(g) The elevator should have re-opening activators located 125 mm +/- 25 mm and 740 mm +/- 25 mm above the finished floor, or other acceptable detector system on automatic doors that automatically reopens the doors fully, or stops the doors, without having to make contact if a person or object passes through the doorway.

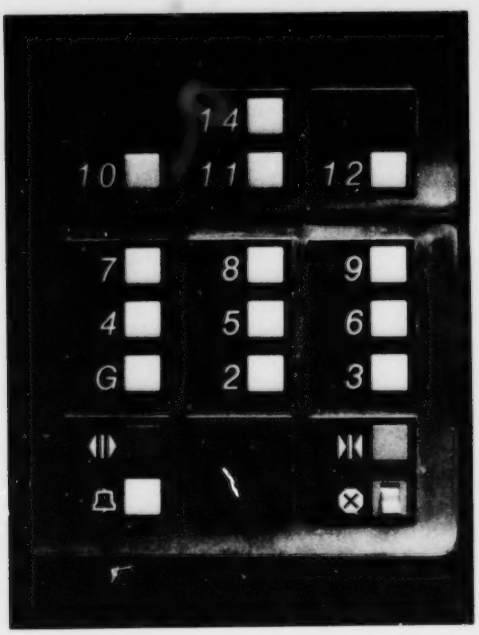
Doors should remain fully open a minimum of 3 seconds in response to a hall call.

(h) The elevator should have a two-way automatic maintaining leveling device to level the car to within +/- 12 mm of the hall floor.

(i) The elevator car should have an emergency communication system which is colour/brightness contrasted from the surrounding surface. The system should be identified with the international symbols for telephones with the symbols being minimum 38 mm high and raised a minimum 1 mm. Other acceptable two-way emergency communication systems may also be used.

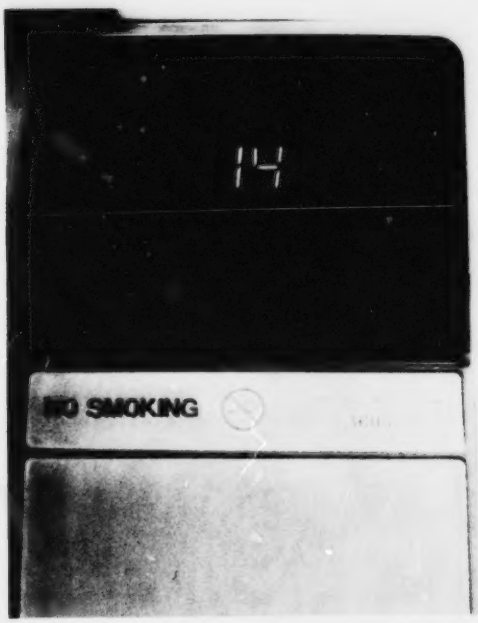
(j) The illumination level within the elevator's interior should be consistent with illumination levels throughout the building and comply with 5.5.1. Doors and the interior of the elevator should be of a non-glare matte finish and should not present a mirrored surface.

(k) Elevators should have an audible cue not less than 24 db that sounds as each floor level is passed. There should also be an audible signal when an elevator stops at a landing; a tone which identifies the direction of travel, or an acceptable verbal annunciator.



(a)

Illustrates an elevator control panel which incorporates very good design features for both low-vision and totally blind persons. While the panel does not have braille on it, the raised numerals are sans serif and easily discernible by touch



(b)

The large print floor display exhibits good colour brightness contrast and is located above the control panel at eye level. This location allows the low vision person to get as near the visual display as necessary to focus on it

Figure 10 Elevator controls and signage

6.2.22 Washrooms

(a) Illumination levels in washrooms should be consistent with 5.5.1.

(b) All signage for washrooms should be consistent with recommendations outlined in 6.2.7.

(c) Washroom doors and walls should be consistent with recommendations outlined in 6.2.13 and 6.2.15.

(d) The entry vestibule, washroom, and interior of water closets should meet all clearance dimensions as outlined in 6.2.3.

(e) Vestibules for the entryway to washrooms often present a myriad of configurations within a given building complex. It is desirable that where a vestibule precedes entry to a washroom, the vestibule design be simple and straightforward in design. Consistent design should be used throughout the building for all washrooms, entry vestibules, and fixtures within the washroom area.

(f) It is desirable that water closet enclosures be colour/brightness contrasted from their surrounding surfaces by a minimum factor of 70 percent.

(g) Where exposed heating or hot water pipes are accessible to persons using the facilities, such pipes should be insulated so they do not constitute a burn hazard to a visually impaired person trailing the wall surfaces.

(h) Accessories

(i) All accessories in the main washroom area such as hand dryers, towel dispensers, waste receptacles, and vending machines should be centrally located and in close proximity to the wash basins.

(ii) It is desirable that fixtures, such as wash basins, towel dis pensers, hand dryers, soap dispensers, urinals, toilets and vending machines, be colour/brightness contrasted from their surrounding surfaces.

(iii) There should not be any projections over the wash basins, e.g. lighting fixtures, soap dispensers, towel dispensers,

which could constitute a hazard when a person is bending over the wash basin.

(iv) Faucets and taps should be of a consistent design and should not have spring-loaded turning handles. Water temperatures at such fixtures should be controlled to assist persons with limited sensation in their hands.

(v) It is preferable that urinals be floor mounted rather than wall mounted. Wall mounted urinals should meet with all clearance dimensions outlined in 6.2.3.

(vi) The toilet or urinal should have accessible hand-operated flushing controls. Foot pedal controls are not acceptable.

6.2.23 Cafeterias/Restaurants/Concessions

Food service areas such as cafeterias and restaurants are by their nature inconsistent in design and are not easily accessible or usable by the visually impaired population. Lighting levels, passageway width and food vending unit designs vary greatly.

Cafeterias present more of a challenge for visually impaired persons than restaurants. Not only must they locate a vacant table and chair but they also must locate the desired food, beverages, utensils and condiments. Most importantly, they must be able to access information about the menu.

(a) All signage, braille, and large print materials in the setting should follow recommendations outlined in 6.2.7. There should be appropriate signage for the exit, food service area, tray return area, cashier, washroom, and cloakroom.

(b) All areas should meet the clearance dimensions given in 6.2.3. The area immediately above table setting should be clear and not encumbered by low-hanging, swag lamps, plants or other decorations at head level.

(c) Display items should be set away from the main service line. Utensils, such as plates and glassware, should be displayed so that they are secure and not easily displaced.

(d) Many restaurants have very low levels of lighting. For low-vision individuals it is especially important that the restaurant or food area have a sufficient level of illumination to be consistent with the main

circulation areas of the terminal. Illumination throughout should follow recommendations outlined in 5.5.1.

(e) It is preferable that the use of turnstiles and posts with suspended queue-guides for entrances and exits be discouraged. These features often are confusing and hinder the access of visually impaired persons using a sighted guide or a guide dog.

(f) Cafeteria entrances should provide an indication of path of travel to the start of the food serving line. In addition to appropriate signage, such a path of travel could be provided by using detectable floor surface differences — texture, resiliency, sound, and/or colour/brightness contrast. A light coloured tile for the pathway and dark carpeting for the remaining area for example; or colour/brightness contrast of any walls leading into the food service area. There should be a clear unobstructed pathway through the food service area.

(g) Cafeterias should utilize clear simple design incorporating good wayfinding principles. Continuous counters to slide trays along is preferable to several separate counters or food service stations. Placement of food, utensils, and condiments should follow a logical sequence.

(h) All hot-food serving areas should be designed so that customers cannot inadvertently come in contact with hazardous heat sources.

(i) Where there are self-serve food areas in a cafeteria line-up with the food displayed behind enclosures, it is preferable that the contents of the enclosures be listed on the enclosure door in large print (18 point print, sans serif type) and braille.

(j) Large print and braille menus should be made available in advance of the food service queue area. Large print menus should be of at least 18 point print and of sans serif type with black print on white paper. The surface of the print menu should be glare free and well illuminated. Braille menus should comply with 6.2.7. Such menus should be kept up to date both in content and pricing; and be posted on the wall in a consistent location by the restaurants or cafeterias throughout the terminal. Menus should be positioned 1350 mm +/- 3 mm above the finished floor.

(k) Vending machines should have large print and braille labels, in compliance with 6.2.7, indicating contents, price and any pertinent directions.

(l) Chairs and tables should be colour/brightness contrasted from their surrounding areas.

(m) Concessions: Entrances to concessions should be clearly defined by flooring surfaces that are detectable in their tactile difference and colour/brightness contrast factor from the main circulation route. To assist with tactile location of entrances from main circulation routes, the main route may be intersected with the different textured flooring surface to indicate an entryway into a concession area.

6.2.24 Baggage Claim Area

(a) Illumination for the baggage claim area should follow recommendations outlined in 5.5.1.

(b) All signage for the baggage claim area should follow recommendations outlined in 6.2.7. It is particularly important that accessible signage pairing each conveyor with the appropriate flight number be made available. Clear signage should identify exits and connecting ground transportation locations.

(c) Clearance dimensions for the baggage claim area should follow recommendations outlined in 6.2.3.

(d) It is preferable that the main route to the baggage claim area utilize a differentiated tactile pathway paired with colour/brightness contrast.

(e) It is preferable that the baggage claim conveyor be colour/brightness contrasted from its surrounding area.

(f) Where there are monitors utilized at the baggage claim conveyor to indicate which conveyor is matched to a specific flight, there should be at least one monitor that is in compliance with recommendations given in 6.2.9.

6.2.25 Construction (See Figure 11)

(a) Construction areas should be closed to public entry.

(b) Properly designed barricades should be in place to prevent public entry into the construction site. These barricades should be cane detectable and colour/brightness contrasted from the surrounding area.

(c) Walkways being utilized by the public should be kept free of debris from the construction site.

(d) All clearance dimensions recommended in 6.2.3 should be complied with for all public walkways on the construction site. Particular attention should be given to bracing or supports used for scaffolding structures.

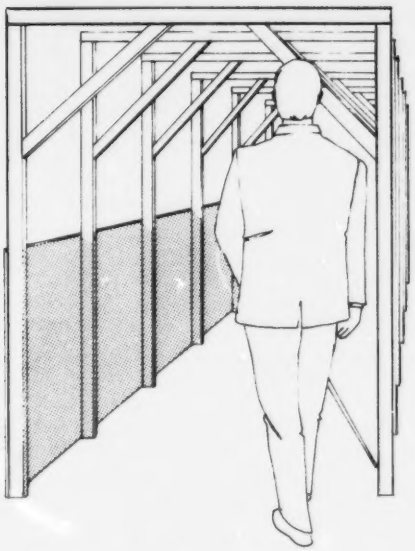
(e) Illumination levels throughout the construction site should comply with 5.5.1.

(f) Signage should comply with 6.2.7 and should be placed in advance of the site to identify the presence of construction and to indicate rerouting of pedestrian traffic.

(g) Construction equipment left unattended, such as ladders, sanders, saws, etc., should be placed behind barricades and should not be present in the public throughway.

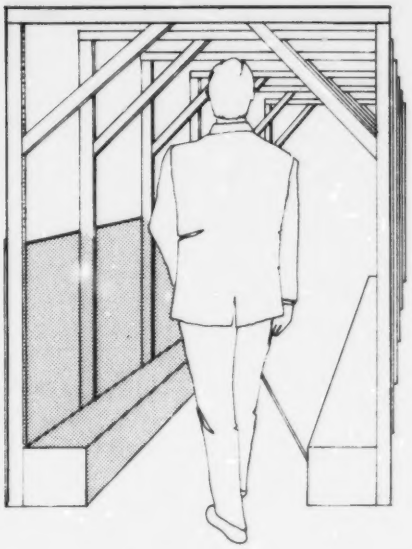
(h) The floor of the public throughway should be a smooth consistent surface. Elevated walkways should have handrails on both sides.

(i) All stairs and ramps should comply with recommendations outlined in 6.2.16 and 6.2.17.



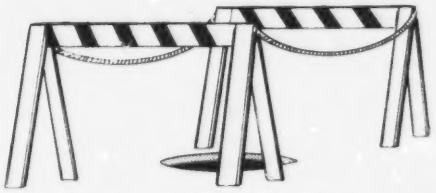
(a)

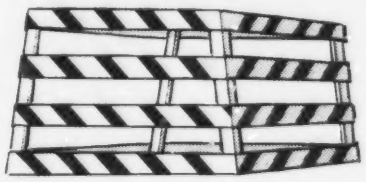
A poorly designed construction barrier which is not cane detectable



(b)

Illustrates a modification to the barrier which allows it to be detected by the long cane and thus prevent possible contact at head height by the visually impaired person





(c)

The common saw horse is not normally detected by the long cane. This barrier serves the same purpose as the saw horse but is cane detectable for visually impaired travellers

Figure 11 Construction considerations

6.3 EXTERIOR

6.3.1 Entrances

(a) Exterior entrance design should comply with 6.2.1.

6.3.2 Walkways

(a) Clearance dimensions for all exterior walkways are: minimum overhead clearance — 1980 mm; minimum clearance width — 1500 mm. The walkway must be free from obstruction for the full width of the walk except that handrails are permitted to project not more than 100 mm from either or both sides into the clear area.

(b) The surface of the walkway should be solid, smooth, level, and kept free of snow, ice and other debris.

(c) The walkway should have a minimum, 75 mm high upturned edge where the vertical drop from the walk exceeds 75 mm., and there are no walls, railings, or other barriers on either or both sides of the walk.

(d) The walkway should have a minimum, 1500 mm wide walk of a detectable difference in texture (under cane tip) to that surrounding it where the line of travel is level and even with adjacent walking surfaces.

(e) Illumination for all exterior walkways should comply with 5.5.1. In particular floodlights should not be positioned so that they shine directly into a pedestrian's face.

(f) It is preferable that stairs be positioned so that the elevation change is not concealed from low-vision persons by shade or other sudden illumination changes.

(g) Guy-wires positioned near walkways should be enclosed with a bright yellow plasticized cover which encircles the guy-wire from the ground up to a minimum height of 1980 mm.

(h) All walkway areas should have curbs where that walkway is positioned beside vehicular routes. The only break in the curb surface should be for curb cuts as outlined in 6.3.4.

6.3.3 Islands

(a) Curbing for islands should follow recommendations for curbing and curb ramps outlined in 6.3.4.

(b) It is preferable that islands not be placed in the crosswalk area. Where such islands exist it is preferable that they be cut through level with the street.

6.3.4 Curb Ramps

(a) The placement of curb ramps should be consistent in location throughout the setting.

(b) Due to the difficulty of detection by most visually impaired travellers, blended curbs or wrap around curb ramps which cover the entire corner of an intersection should not be employed.

(c) It is preferable that curb ramps with flared sides be utilized as illustrated in Figure 12, and that the design utilized be consistent throughout the setting.

(d) The entire surface of the curb ramp, including the flared sides, shall have a detectable warning surface as outlined in 6.2.5.

6.3.5 Stairs

All aspects of design for exterior stairs shall be consistent with recommendations in 6.2.16 and with the following recommendations.

(a) Stairway system should be maintained free of snow and ice. If an exterior stairway cannot be covered, an appropriate sub-surface heating system could be considered as a means of keeping the stairway free of snow and ice.

(b) Construction of exterior stairs should consider drainage factors and the necessity to maintain the stair surface free of dirt and debris.

(c) Stair surfaces should consist of glare-free materials. Consistent illumination should be provided for evening travel. The artificial illumination of exterior ramps, at night, should meet requirements outlined in 5.5.1. The illumination should be positioned such that glare and shadows are minimized. All illumination systems, such as spotlights, should

be directed onto the stair surface rather than directly into the individual's face.

6.3.6 Ramps

All aspects of design for exterior ramps shall be consistent with recommendations in 6.2.17 and with the recommendations given below.

(a) Ramp systems should be maintained free of snow and ice. If an exterior ramp cannot be covered, an appropriate sub-surface heating system could be considered as a means of keeping the ramp free of snow and ice.

(b) Construction of exterior ramps should consider drainage factors and the need to maintain the ramp surface free of dirt and debris.

(c) Ramp surfaces should consist of glare free materials. Consistent illumination should be provided for evening travel. The nighttime illumination of exterior ramps should meet requirements outlined in 5.5.1. The illumination should be such that glare and shadows are minimized. All illumination systems, such as spotlights, should be directed onto the ramp surface rather than directly into the individual's face.

6.3.7 Landscaping

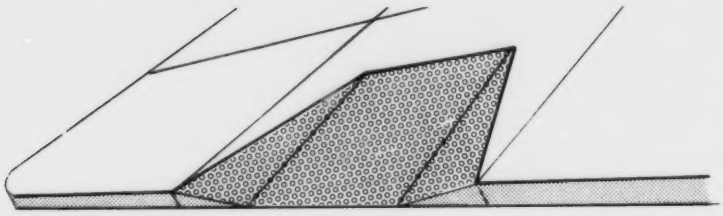
(a) Landscaping should comply with 6.2.3 clearance dimensions.

(b) It is preferable that thorny plants not be used immediately adjacent to walks. (Illinois Accessibility Standards).

(c) It is preferable that plants that drop large seed pods not overhang, or be positioned near, public pathways. (Illinois Accessibility Standards).

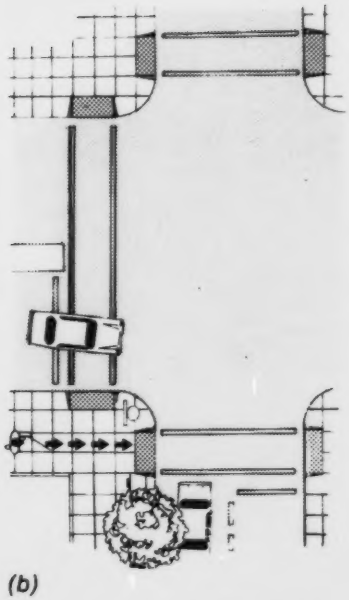
6.3.8 Gratings

(a) Gratings, manhole covers and other access covers should be placed outside walkways whenever possible. When circumstances require their presence on walkways, gratings should have open spaces no greater than 13 mm in one direction. In order to minimize cane tips catching in gratings, it is preferable for the cane user that the surface of gratings be of the sieve type rather than the flat elongated grid type. If the gratings have elongated openings they should be positioned so the



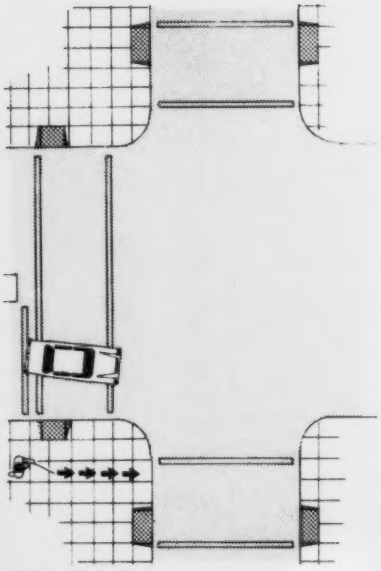
(a)

The recommended flared curb ramp with the detectable warning surface



(b)

Placement of the curb ramp in the direct line of travel



(c)

Placement of the curb ramp outside of the direct line of travel yet still within the crosswalk area. The ramp illustrated is the preferred consistent placement for most visually impaired travellers; however, size of crosswalk and curbside obstacles do not always allow for this offset placement of the curb ramp

Figure 12 Curb ramp design and placement

long dimension is at right angles to the main pedestrian flow pattern. Solid covers occurring in walkways should not have changes in the vertical surface dimension that exceed 15 mm.

6.3.9 Parking

(a) Parking lots should conform with the clearance dimensions as recommended in 6.2.3; illumination as recommended in 5.5.1; signage as recommended in 6.2.7; and landscaping as recommended in 6.3.7.

Pedestrian access from the public transit system should not require crossing a parking lot in order to arrive at the main accessible entrance of a building.

(b) Wheel stops, landscaping, or other design features should be in place in order to prevent cars from parking so that their bumpers are protruding over the walkway.

(c) Where wheel stops or other curbing projections are present in the parking lot, these should be painted with a bright yellow colour/brightness contrasted paint to assist their identification by low-vision pedestrians.

6.3.10 Traffic Lights for Pedestrian Walkways

(a) It is preferable that access be gained directly to the terminal's main entrance via public ground transportation without having to cross main traffic thoroughfares.

(b) When main traffic thoroughfares must be crossed to access the terminal, pedestrian walkways should be provided connecting the main accessible entrance of the terminal to public transportation depots or parking lots. These walkways must be colour/brightness contrasted to their surrounding surface. It is preferable that these walkways have pedestrian-controlled traffic-light signals. The location of the signal button must be beside the crosswalk and consistently located throughout the setting for all crosswalks. It is preferable that the signal button be colour/brightness contrasted to its immediate surroundings.

(c) Traffic light signals should be clearly visible from both sides of the crosswalk and the design of the light fixture should be of the standard vertical position with the red light on top, yellow light in the middle, and the green light on the bottom.

(d) Auditory traffic light signals are only recommended for pedestrian crosswalks where there is no cross traffic to offer sound cues to indicate light changes, e.g. crosswalks located in the middle of a block.

Visually impaired persons rely on the auditory cues of traffic flow patterns and any residual vision they may have, to know when to cross a street safely. When properly utilized these cues provide reliable, natural sources to assist with safe street-crossing methods. Auditory traffic signals which provide a sound cue to indicate traffic light signal changes can prove to be hazardous when their presence creates over-dependence and over-confidence on the artificial sound cue which results in less caution being exercised by the visually impaired traveller.

The possible negative effects of such over-dependency are clear when one considers: the number of vehicle drivers who continue through an intersection against a red light; the possibility of the audible sound cue of the device masking nearby traffic sounds; and the presence of malfunction in the device which could conceivably result in auditory miscues. Therefore, auditory traffic light signals should only be considered for a crosswalk following the evaluation of the crosswalk setting and the recommendation of installation of such a device by the local consultation team, (see 5.2).

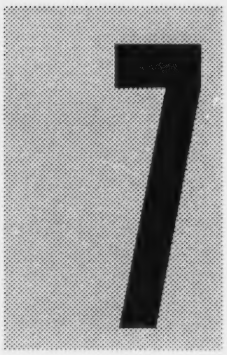
(e) Where auditory traffic light signals are utilized, they should be closely monitored for mechanical malfunction. The auditory sound cue should be clearly audible above the ambient noise of the crosswalk area. The sound source should be emitted from the opposite side of the crosswalk to assist the pedestrian in localizing the sound source during crossing.

(f) All traffic signals must be set such that sufficient time is readily provided to pedestrians to complete the crossing.

6.3.11 Construction

(a) All recommendations outlined in 6.2.25 should be met.

CONCLUSIONS AND RECOMMENDATIONS



7.1 GENERAL RECOMMENDATIONS ON TECHNICAL SOLUTIONS

Technology can help open new opportunities for blind and visually impaired persons; however, it is important that technology does not also further segregate them. Planners are often tempted to try to solve the problems of all disabled persons with one all-encompassing disability design. When this approach is taken, sensory impaired persons, as a less visible segment of the disabled population, usually end up with little done for them.

Solutions for visually impaired persons almost always help the general public, especially the elderly. Better communication systems and better orientation strategies help everyone. Therefore, solutions such as lowered monitors, help lines for information, and talking signs should be set up so that they are an integral part of the terminal systems rather than a parallel system.

Research for this project has uncovered dozens of international and Canadian studies covering most of the areas addressed by this report. We found that information held by one authority was not always shared with national service and consumers groups for blind and visually impaired persons or with other researchers and authorities in Canada and abroad.

An active research, development and implementation atmosphere exists in Western Europe. And Canada has a seat on a multination European group on transportation for the disabled. This seat is filled by a representative from the Canadian High Commissioner's office in London, Eng. We recommend that Transport Canada be regularly advised of the proceedings of these meetings or be represented.

For current information on European developments, contact Anne Frye, Disability Unit, Department of Transport, British Government, R 516, 14th Floor, 2 Marsham Street, London, England. Ms. Frye is Chairman of the European group and a British Government contact on transportation for the disabled. However, we caution authorities to recognize that technological solutions are not useful without analysis by visually impaired persons. CNIB and the Canadian Council of the Blind are willing to assist researchers and implementers in accessing consumer feedback.

We have found that much research is taking place to ensure that where technology can assist a visually impaired person in better dealing with life's challenges, a product is developed. However, we caution our readers that technology cannot and should not replace interaction with knowledgeable, trained people. Rather, technology should assist people, blind and sighted, in carrying out their daily functions.

Finally, research, development and study are meaningless without implementation. Too often likely solutions have been found and documented but demonstration projects and/or standardization of use have not followed. Rather than searching for new solutions, we recommend that available dollars be spent on demonstration projects which make use of existing technology (sometimes with modifications) and on standardization of the application of these technologies and systems.

The technology is available. All that is required is the will to involve and demonstrate.

In summary we recommend that:

(i) Access technologies for the visually impaired population be implemented as an integral part of the terminal systems rather than as a parallel system.

(ii) Terminal designers and operators call upon a consultation team (5.2) to analyze proposed technological solutions to access problems.

(iii) Technology be implemented primarily to assist people, blind and sighted, in carrying out their daily functions. Technology should not be used to replace interaction with knowledgeable, trained people.

(iv) Available dollars be spent on further research on technological adaptations for visually impaired persons, on demonstration projects for existing technology (sometimes with modifications), and on standardization of the application of technologies and systems.

7.2 SIMPLE SOLUTIONS TO ACCESS PROBLEMS

Not all solutions need be complex, expensive, or highly technical. For orientation, visually impaired persons need information. Often this means making existing information more readily available to them by simple techniques. Recommendations for implementing this approach include:

(a) Lowering to eye level, 1350 mm +/- 3 mm above finished floor surface, one set of arrival/departure video monitors in each terminal. This will allow people with low vision to get as close to the screen as is required. (One means of magnification is bringing the object closer.) Lowered monitors should be consistently located in all terminals.

(b) Providing inexpensive, low-vision aids, such as bar magnifiers, at locations where travellers are expected to read documents or material in print, e.g. telephone stands, customs information pamphlet racks, schedule racks. The bar magnifier could be attached to the stand/rack with a light chain to prevent loss. Proper lighting levels would also be required.

(c) Offering information on schedules, special services, and terminal orientation as close as possible to the main public entrance. This is best done by a staffed information booth but could also be handled by a direct telephone line located in a consistent position throughout the settings. The phone could be tied directly to an existing information booth elsewhere in the terminal, an office in the terminal where existing staff could provide the required information, or to a regional or central information system where information specialists are available to respond. In short, a telephone consistently located in terminals and connected to knowledgeable people could be the major technology required.

(d) Providing warnings of dangerous or off-limit areas by using currently available break-the-light-beam technology. When a visually impaired person (or any person) breaks a light beam near these areas, a voice loop or synthesized voice could announce "restricted area — do not proceed" or some similar warning message.

(e) Terminal operators negotiating with the authorities responsible for surrounding roadways and crossings for the implementation of useful and safe audio-tactile cueing. Visually impaired persons must not only be able to move safely and purposefully within terminals; they must also be able to arrive and depart from the terminals safely, whether it be on foot or via bus, car or taxi. Adjustments in traffic controls to assist visually impaired travellers are generally also of benefit to the general public, the elderly, persons with mobility handicaps and children.

(f) Improving illumination and signage in terminals as recommended in this manual.

7.3 AREAS REQUIRING ADDITIONAL RESEARCH

7.3.1 Detectable Warning Surface

We recommend that further research be undertaken relating to the application of a detectable warning surface to curb ramps and stairways before the material is more broadly specified. Immediate research is required to select a consistent detectable warning surface. Earlier research has confirmed application of one type of surface for elevated platforms. It is important that one type of surface be selected for consistent warnings in all three applications. The usability of the surface tested for elevated platforms (see Appendix J) should be carefully researched to determine if this surface might be effective for curb ramp and stairway applications. On-site analysis should form part of this research with due consideration being given to the Canadian climate.

7.3.2 Model Demonstration Site

We propose that a model terminal be selected to serve as a demonstration project for many of the recommendations and technology suggestions outlined in this report. Actual on-site analysis of their effectiveness for visually impaired travellers could then be undertaken on the selected site.

7.3.3. Talking Signs (See Appendix A)

This technology offers interesting potential for reducing orientation problems for some visually impaired travellers; especially in bigger terminals with large open areas that do not have good orientation cues. Indeed, Canadian studies, such as Transport Canada report TP4038E

on *Communication Aids for Travellers with Sight/Hearing/Speech-Disabilities* (Hayto, McDougall, Walsh), as far back as 1982 recommended a talking sign demonstration project. The technology exists and continues to improve but little action has taken place towards implementation. We recommend a demonstration project with the aim of further investigation into the applicability of talking sign technology.

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TECHNOLOGY FOR BLIND & VISUALLY IMPAIRED PERSONS

APPENDIX

A

A1 Low-Vision Aids

A2 Current Technology for Providing Large Print, Braille, Speech Access and Audible Warnings

A3 Annotated Bibliography of Data Bases and Reviews of Technology for Blind and Visually Impaired Persons

A1 Low-Vision Aids

A1.1 General

Because every visually impaired person is unique, an important step for most low-vision persons is to determine the most beneficial low-vision aids for their individual needs. To do this one takes part in a low-vision assessment conducted by a low-vision specialist. Some low-vision persons use several types of low-vision aids for discerning visual information when travelling.

There exist literally thousands of specially designed technical and low-vision aids for blind and visually impaired persons. These aids range from simple needle threaders (at a unit cost of less than $1.00) and hand magnifiers, to closed circuit television readers (CCTV's) and highly sophisticated multi-font optical character readers (OCR) which replicate near-human speed, e.g., the Kurzweil Reading Machine at a cost of over $40,000.

Statistics Canada reports that more than 75 percent of blind and severely visually impaired persons use technical aids. While these technical aids are of assistance, their use may make travel more difficult. A cane, guide dog, monocular, or computer access device may occupy one arm or both. Coupled with briefcases and luggage, it is easy to imagine the increased pressure on a blind or visually impaired traveller. At times, the use of assistive devices must be balanced by their liabilities.

While not all technical aids are specifically relevant to accessing terminals, personnel should be aware of the range of devices used by blind and visually impaired persons. These aids provide sight enhancement for low-vision travellers and provide sight substitution for blind persons. They fall into the following categories:

- aids for daily living
- low-vision aids
- medical aids
- orientation and mobility aids
- reading aids.

In addition to these aids, hundreds of recreation products have been adapted, e.g., braille and large-print scrabble, audible footballs, talking bridge games, tactile chess, large-print and braille bingo. Much research is taking place to ensure that where technology can assist a blind or visually impaired person in better dealing with life's challenges, a product is developed. Technology cannot, and should not, however, replace interaction with knowledgeable, trained people. Rather, technology should assist people, blind and sighted, in carrying on their daily functions.

A1.2 Aids for Daily Living

A broad group of aids help blind and visually impaired persons deal with problems of daily living. These include large print-raised telephone dials, tactile labels for clothes, and signature guides.

A1.3 Low-Vision Aids

There are hundreds of small low-vision aids including the familiar hand magnifiers, stand magnifiers, bar magnifiers that rest on the surface to be read, and binoculars and monoculars for distance vision. Most of these low-vision aids reduce the field of vision and restrict the ability to view objects to the sides, above or below the field viewed through the device. The stronger the magnification, the more restricted the field of view.

Filtering lenses come in a range of lens sophistication. While some people use filtering lenses to mask unsightly eye conditions, many visually impaired persons use them to reduce glare and enhance contrast. Lenses have been developed to reduce glare while maintaining visibility; some individuals may use unusually tinted lenses indoors to reduce illumination and enhance contrast. A negative side effect of many filtering lenses is the further reduction of necessary light in poorly lighted areas.

A range of more sophisticated low-vision products, such as closed circuit television (CCTV), allows the magnification of any size or style of print up to 64x and the choice of positive or negative polarity on the same screen (e.g., white on black or the reverse). These devices are not readily portable but are useful in reading-room, office and educational settings.

Similarly, there exists a range of computer peripherals and software which allows the user to magnify sections of the screen. Generally keyboard access is required. See Section A3.

A1.4 Medical Aids

The majority of blind and visually impaired persons are elderly. Many are multi-disabled with conditions such as diabetes (one of the leading causes of blindness), heart disease, strokes, developmental delay, and deafness or hearing difficulties.

As diabetes is one of the leading causes of visual impairment during the working years, visually impaired, diabetic travellers may carry adaptive equipment ranging from tactile and/or large print devices to measure insulin to devices for taking blood sugar levels.

Medical aids also include talking and tactile thermometers and blood pressure gauges, braille/large print pill-boxes, and similar items. Deaf-blind aids combine the tactile properties of aids for the blind with alerting equipment for the deaf.

A1.5 Orientation and Mobility Aids

This group of aids typically includes short, white, identification canes, longer white canes for use with the touch technique, larger canes, a variety of electronic travel aids worn like eyeglasses or on the chest, dog guides, and a range of distance low-vision aids such as monoculars, binoculars, telescopes and filtering lenses. Electronic mobility aids on the market include:

- **The Mowat Sensor**. A hand held device which transmits a beam of high-frequency ultrasound that is reflected off obstacles in the immediate environment and returned to the receiving unit on the device. The user is provided with a vibratory signal when obstacles are detected. The rate of vibration of the device provides the user with information concerning distance of the detected obstacle. The Mowat Sensor is primarily employed for obstacle detection. As such it detects and locates objects and provides information that allows the user to determine (within acceptable tolerances) range, direction, dimension and height of objects. It makes non-contact trailing and tracking possible, enabling the traveller to receive directional indicators from physical structures that have strategic location in the environment (10).

  Much as a torch must be directed to the source one wishes to illuminate, the Mowat Sensor must be directed to the path of travel one wishes to clear. Due to its inability to detect elevation

changes, the Mowat Sensor is most frequently used as a secondary device in conjunction with a long cane or guide dog.

- **The Laser Cane.** This cane can determine obstacles in the path of travel and can also detect elevation changes that are greater than 15 cm. The Laser Cane operates by emitting pulses of infra-red light which, if reflected from an object in the travel path, are detected by photo-diodes located behind the receiving lens. Three pencil thin beams of infra-red light are sent out from the device to determine elevation changes, objects at head height, and objects in the travel path. The user of the Laser Cane is notified of objects by audible signals emitted from the cane. In addition to the audible signal, the Laser Cane also has a tactual signal for objects determined to be in front of the user. This feature allows the user the option of eliminating the forward audible signal at times when a quieter presence is desired. The Laser Cane also has a model for deaf-blind users that provides the same environmental information by tactual cues. Unlike the other two devices discussed in this section, the Laser Cane is a primary travel aid, hence there is no need to pair it with a cane or dog guide.

- **The Sonicguide**. An environmental sensor which provides more information about the environment than simple obstacle detection. Through the interpretation of audible signals, the Sonicguide provides information about the surface characteristics and density of objects in the environment. For example, by listening to the quality of the sound the skilled Sonicguide user can discriminate between a person standing on the corner and the bus stop pole. The Sonicguide emits pulses of inaudible high frequency sound ahead of the user from small transducers mounted on a pair of spectacles. The sound reflects back from objects within the ultrasonic field, is converted to an audible signal and is fed to binaural receivers for interpretation by the user. The distance of an object is conveyed by the perceived pitch of the sounds produced. The pitch continuously goes lower as the distance between the traveller and an object decreases.(10) When used correctly the Sonicguide is able to detect the presence of head height obstacles. Due to its inability to detect elevation changes, the Sonicguide is most frequently used as a secondary device in conjunction with a guide dog or long cane.

Additionally a recent development in Canada has been the Sensory-6 electronic travel aid. This is a secondary travel aid to be used in conjunction with another mobility device and operates by sending out ultrasonic waves and detecting the pattern of waves that

bounces off objects in front of it. The Sensory-6 produces tones in the earphones corresponding to the distances of the objects.

A1.6 Reading Aids

Voice, whether recorded, synthesized, or human is a key source of information for blind and visually impaired persons. Many blind persons read books recorded and distributed by public libraries and service agencies for the blind. Most books and magazines for blind persons are recorded for use on 4-track, 1/2 speed machines, thus allowing one cassette to hold four times the amount of recording. These types of machines used by blind and visually impaired persons generally are able to read standard 2-track tapes. Therefore, people interested in communicating information to this audience should consider the use of audio tapes.

Using variable-speed players, blind and visually impaired persons generally read at a rate faster than normal speech.

Other voice-reading devices include optical character scanners (OCS) that convert print off paper into synthetic voices of varied quality. The cost of the OCS usually dictates the range of fonts it can read and the voice quality.

Many synthesized-voice, computer chips are designed for special purposes, talking signs to allow blind and visually impaired persons access to information given the general public, for example. These chips also are used in such products as talking watches and talking calculators.

Large print and magnification devices are important print access vehicles. See Section A2.2. When using a magnification device to read maps, monitors or other print materials means, individuals require a close viewing situation. Information should be positioned with this requirement in mind.

Braille is used by 8-10 percent of blind persons. It includes a grade one form of the alphabet, punctuation and numbers, and a grade two form (used for books) which is much like shorthand in function. To create hard-copy braille, blind persons (or transcribers) use a range ofproducts, e.g.,small slates and styli (punches), typewriter-like braillers, personal and mainframe computers with braille printers.

Paperless braille also exists. A device the size of a large book takes information from a computer (on cassette or disc) or from keystrokes on the device and emits the information via an array of electronic braille cells which refresh themselves with new information at the command of the user. These devices have opened the world of computerized information and data bases to blind people.

Braille will continue to be important to many blind persons, particularly for detailed information which needs to be reviewed more than once.

A2 Current Technology for Providing Large Print, Braille, Speech Access and Audible Warnings

A2.1 General

This section gives an overview of the current technology available to the blind and visually impaired population of Canada.

A2.2 Technology for Providing Large Print

Details for the proper provision of braille for pamphlets and other information directed to the public are given in Section A2.3. Suggestions for use of simple, low-vision magnifiers are given in Section A1. At times, however, stronger magnification or enhanced and enlarged computer-generated print may be required to allow visually impaired persons to access information.

Regular print may be converted into large print by using enlarging photocopy machines. This is a good system for small quantities of information. Other ways of providing large print include using graphic programs to produce large print on standard computer printers. Closed Circuit Television Systems (CCTV's), which use a black and white or colour camera and a monitor of 30 to 48 cm, allow the user to enlarge print (e.g., schedules, application forms, cheques) up to 64x in size. The CCTV's allow for black-on-white or inverse (white-on-black) images. A range of CCTV's is described in the data bases listed in Section A3. The cost of these systems is in the $2,500-$3,500 range.

Sometimes closely approaching a video monitor or computer monitor is not good enough for a variety of reasons, e.g. the print is too small, the image is hazy or flickering. There are many software and hardware systems (ranging in cost from $500-$2,000) which enlarge sections of the screens up to 64x. Most of these systems are discussed in the referenced data bases. Worth particularly close study are the mouse driven VISTA system by TSI and the Canadian-made, high-quality, well-priced ($500-$900, depending on specification) Lyon Aid system. The Lyon Aid system requires a keyboard availability while VISTA can be adapted without keyboard access. Main frame computer systems can be adapted, through the involvement of appropriate professionals, to ensure access by visually impaired persons.

A2.3 Technology for Providing Braille

We estimate that braille is read and used by less than 10 percent of blind persons in Canada. While this group is small, braille is an important medium to the group, especially for reviewing detailed information.

The easiest means of providing public information (pamphlets, schedules, notices) to braille users is by contracting with suppliers, such as the CNIB, for translation into braille. (The names of other suppliers can be provided by Supply and Services Canada). Translation by trained translators ensures accuracy and proper formatting.

The advent of the personal brailler has made it easier for smaller organizations to provide acceptable, medium-quality braille very quickly. All that is required is an office computer and a special personal brailler and software package. (Cost is in the range of $5,000.) With a small amount of training, office staff can translate print letters, notices, or schedules into braille. One device, the *Otsuki Printer*, produces print and braille on the same page. Detailed information on the braille printers and accompanying software is available from the data bases listed in Section A3 and from a regional CNIB Technical Aids Centre.

Access to computer screens can be provided by using electronic paperless braille devices (see Section A3). More than a dozen such devices are available. The most common in North America are the *VersaBrailler* by TSI and the *Braille Display Processor* by V-Tek. Connected to the computer by an RS-232 cable, the paperless braille machine allows the user access to 10-80 characters of the screen at a time. The user can move about the screen with relative ease. The devices, priced from $5000-$10,000 are expensive and require regular care and servicing. However, for braille users, these devices are more useful than speech output devices when it is necessary to search through screens containing columns and details, e.g., arrival/departure listings.

Deaf-blind persons may use the equivalent of a TTY machine for telephone communication. The Telebraille from TSI converts the TTY letter characters into braille and allows reverse translation of braille to TTY print for communication by the deaf-blind person to the terminal which has TTY equipment.

A2.4 Speech Technology

Virtually any micro-computer can be converted into a talking computer. Usually all that is required is software or hardware and speakers. Depending on the quality of speech required, the cost may range from a few hundred dollars up to $l,000-$4,000 for near human-quality speech. Until recently these products were available only in English, but now reasonable quality French or bilingual systems have become available.

A new product, *Delta*, to be released in North America in 1988, combines braille and/or speech readout in French and English (plus the possibility of German and Swedish). The Delta is portable but will cost about $12,000.

Most speech access devices are designed to be used with a keyboard. Some research and development doubtless will be required to allow simple voice access to information on monitors with a small number of control keys. A system likely could be converted from existing technology into a reasonably priced product. This voice system could be set up as part of the consistently located, lowered-monitor setup.

As stated earlier, the simplest and best voice system to access is the human voice of an information person. An inexpensive alternative to a real person (at an information kiosk or at the end of of a telephone line) is well planned recorded messaging to give schedule information, description of the physical setup of terminals, etc.

A2.5 Audible Traffic Signals

Considerable work has been done internationally in this area. Work in Canada is very well documented in MANOP Services Limited's Pedestrian Crosswalk Systems for the Elderly and the Handicapped (Transport Canada File #D1450-103-26, 1984). This report reviews Canadian and international installations and systems. It recommends a demonstration project of state of the art technology and the development of a standard. CNIB concurs. The report also suggests a need for 300-750 installations out of 10,000 signal controlled intersections in Canada.

However, auditory traffic light signals are only recommended for crosswalks which offer such complexity that clear consistent traffic flow pattern sound cues are not readily available.

Visually impaired persons rely on the auditory cues of traffic flow patterns, and any residual vision they may have, to know when to safely cross a street. When properly utilized these cues provide reliable natural sources to assist with safe street crossing methods. Auditory traffic signals which provide a sound cue to indicate traffic light signal changes can prove to be hazardous when their presence creates over-dependence and over-confidence on the artificial sound cue, resulting in less caution being exercised by the visually impaired traveller.

The possible negative effects of such over-dependency are clear when one considers: the number of vehicle drivers who continue through an intersection against a red light; the possibility of the audible sound cue of the device masking nearby traffic sounds; and, the presence of malfunction in the device which could conceivably result in auditory miscues. Therefore, auditory traffic signals should only be considered for a crosswalk following the evaluation of the crosswalk setting and the recommendation of installation of such a device by the aforementioned local consultation team.

Current technology in Canada comes from a number of commercial companies but also includes many homemade devices with a variety of frequencies, sound levels and activation systems. Several Canadian cities are using the new Japanese technology which includes 'touch-posts' to which blind persons are led by a line of special patterned pavement tiles identified through the feet. The signal control button is on the touch-post and activates an audible signal on a post facing the pedestrian.

Improvements in audible signal designs include better directionality and tone changes to indicate the time duration change of 'green man' phases (e.g., system by *El-SI s.a. of Bordeaux, France*). Several countries have experimented with tactile signals for blind and deaf-blind persons. A signal disc (under the push-button, green-phase activator) rotates in the green phase. This provides a signal for deaf-blind persons and elementary audio signals in areas where sounds may be inappropriate or ineffective. Vibrating signals are most useful in conjunction with audio signals. For a comparison of audio and tactile signals see *Development of an Audio Signal to Assist the Blind at Pedestrian Crossings*, Louis A. Clallis & Associates, Australian Government, Department of Transport, 1978 and *Audible and Tactile Signals for Blind Pedestrians at Intersections Controlled by Traffic Light Signals*, European Conference of Ministers of Transport, Voice of the Pedestrian, #2:37-43, February 1985.

An interesting version of the audible traffic signal is the talking traffic signal as described in *The Talking Pelican Crossing: The Introduction of a Novel Aid for the Blind*, in Traffic Engineering and Control 23(5):284–67, May 1982. This system provides for human voice messages announcing when it is safe to cross and in which direction it is safe to do so.

The human voice message is recorded 22 times on a three-minute loop and is activated when the pedestrian pushes the control button. A male recorded voice announces when there is a green light to cross X Street while a female voice on another pole announces when it is safe to cross Y Street. The system therefore provides for orientation as well as safety. The security of a human voice is important as is the precision of the message. The sound is localized and can be combined with a secondary auditory cue across the street to give direction to the traveller.

A2.6 Underground/Underfloor Cable Signalling Systems

A number of technologies (e.g., the Berlin Senate) have been developed which use a radio wave transmitter/receiver system to guide blind travellers over a route or to indicate the status of traffic lights. These systems require the installation of a wire loop under the surface over which the blind person is to walk. The loop issues waves which contain information (current state of traffic lights), on or off track signals by intensity of sound and location of specific objects (traffic light standard) which is received by a receiver in the blind person's cane or in a device worn on the blind person.

These systems are expensive and require users to wear or carry expensive receivers with single purpose function. In the long range this approach may be useful if the receiver can also serve other functions e.g., tailing sign receiver, paper currency receiver. In the short term, other orientation and guidance projects would appear to provide quicker paybacks.

A2.7 Talking Signs

This technology offers considerable potential for reducing orientation problems for blind and visually impaired travellers, especially in bigger terminals with large open areas that do not have good orientation cues. Indeed, Canadian studies, such as the Transport Canada report TP 4038E on *Communication Aids for Travellers with Sight/Hearing/ Speech Disabilities* (Hayto, McDougall, Walsh) as far back as 1982,

recommended a talking sign demonstration project. The technology has existed and has continued to improve for many years but little action has taken place towards implementation.

A note on speech quality is appropriate in relation to talking signs and other speech output systems. The November 1986 report *Information Systems for Low-Vision Persons* (Muller-Munch Associates) prepared for the U.S. Architectural and Transportation Barriers Compliance Board states that "speech devices or 'talking signs' were found to have statistical and practically significant intelligibility differences. Human speech or digitized human speech, wherein the human voice is recorded on a microchip, was radically more intelligible than synthesized speech, wherein the sound is electrically generated using speech algorithms." The report goes on to suggest that the human ear is the best judge of speech quality as frequency and spectral tests are inconclusive.

Talking sign technology is one version of broadcast system technology. This range of technology is described by Hayto, McDougall, Walsh, as follows:

> *"Typically, broadcast systems transfer audio information directly from the information source to the listener utilizing a transmission other than sound waves. The method, therefore, requires the use of specialized transmitters and receivers. The advantages of using a broadcast system rather than simply using a public address amplifier and speaker include selectivity of audience and isolation from ambient noise.*
>
> *The simplest broadcast system is commonly referred to as the loop system. In this system, a loop of wire surrounding an area is connected to a device very similar to a standard public address amplifier and broadcasts to receivers capable of sensing magnetic field modulation and converting it into audible signals.*
>
> *Another broadcast system utilizes radio-frequency transmission similar to that used by radio stations. Two systems are now in use, amplitude modulated (AM) and frequency modulated (FM). Electronically, AM is slightly cheaper and simpler, but FM provides improved speech quality.*

A third system, referred to as talking signs or talking lights, utilizes a light beam which is modulated with audio information. A unique advantage of this system is that the directionality of the light beam can provide improved orientation information for the blind or sight-impaired traveller."

Some versions of talking signs are well established and are used for orientation. These include: talking elevators such as those distributed by EVA-Electronic Voice Announcer Corporation of Ottawa and Les Ascenseurs Labadie Inc of Montreal. Other talking signs have potential for issuing orientation information such as light beams which, when broken, would cause a warning message to be activated.

Several interesting developments in electronic signalling and sign technology are emerging in Great Britain. The UK Transport Department is investigating the use of tiny transponders that could be carried by disabled people to allow special equipment on pedestrian crossings to recognize their presence and automatically lengthen the period the traffic lights allow for safe crossing. (Traffic light intervals are designed for normally active people, hence, for blind and visually impaired persons the interval is often too brief.) The Transport Department's traffic control and communications division, which is working to solve the traffic and road problems of the disabled, said the transponders would be powered by a long-life battery to give a service life of up to ten years. A tele-electronic tag could also be used to trigger synthesized verbal announcements for blind people.

A2.8 Talking Bus Stop

The UK Transport Department is trying out a new talking bus stop in Weston Super Mare, Western England.

The electronic speech information system, known as Elsie for short, will, at the push of a button, tell blind people when buses are due and announce their route numbers as they approach. The bus stop's built-in microcomputer will store information on such things as bus timetables for routes using that particular stop. It will also be able to tell people of any holiday variations in the service.

Voice synthesizers also could be installed on buses and programmed to announce the vehicle's imminent arrival at named stops. Electronic loops put in the road to activate the talking bus stop when a bus is approaching would, in this case, be reversed to trigger arrival

announcements on the bus. The on-board synthesizer could be adapted further to announce the bus route number and destination to waiting passengers each time the vehicle doors were opened.

If talking signs were installed at key points in terminals e.g., ticket desks, information counters, departure lounges, restaurants, washrooms, and if blind persons were issued receivers, the blind persons could orient themselves. When activated, the receiver would announce via a small speaker or earphones the names of key orientation points in the direction it was pointed. The angle of the beam used is important to ensure ease of finding the transmitters (signs). One study, from the University of Uppsala, Sweden, suggests that an angle of around 24 degrees is the best choice.

Talking sign technology may not be overly expensive. Its practicality and the basis of receiver distribution need to be studied and demonstrated.

In studying the implementation of talking signs and other audio technology, researchers should also examine the 'musical patterning' technology being demonstrated in New York by the Americas Foundation for the Blind in co-operation with the Massachusetts Institute of Technology. This system uses sequentially activated speakers to direct blind persons to specific locations in a building. To activate the system, a button is pushed at a central location. At the first audio cue, sensors detect a tag on the person and they activate subsequent audio signals until the destination is reached. A personal computer controls the system.

The technology is available. All that is required is the will to involve and demonstrate.

A3 Annotated Bibliography of Data Bases and Reviews of Technology for Blind and Visually Impaired Persons

As dozens of excellent resources exist, it would be foolish in this appendix to replicate existing data bases and information sources on technology for blind and visually impaired persons. Most books and journals referred to in this section are available at CNIB Technical Aids Centres or from the CNIB Sherman Swift Reference Library, 1929 Bayview Avenue, Toronto, Ontario, M4G 3E8.

As previous sections of this document deal with technology with specific application to transportation terminals, and many low tech devices are personal aids to daily living, the references in this section largely relate to computer enhancing peripherals which allow access to computer systems by blind and visually impaired persons.

From the resources given in this section, the reader will be able to determine appropriate technology to allow computers to be adapted for blind and visually impaired persons on synthesized speech, large print characters, or braille. Braille can be provided via paperless braille reading devices (braille displays) or via hard copy braille from a braille printer. Large print may be provided by means of character enlarging software or hardware, large print printer, by magnification or by allowing readers to approach within a few inches of the monitor in some cases.

A wide range of speech, large print, and braille devices exist. Costs vary from a few hundred dollars to tens of thousands of dollars. Generally, however, costs have come down and prices are more reasonable. As an example, a braille printer which, given a standard computer, allows written communication with a blind person, may cost less than $4,500.

ABLEDATA

National Rehabilitation Information Center
The Catholic University of America
4407 Eighth Street, N.E.
Washington, D.C. 20017
(202) 635-5826

A national computerized databank containing information about rehabilitation products: available through a network of information brokers across the United States. This is a free service which includes some information on specialized computers and computer-related technology.

A BEGINNER'S GUIDE TO PERSONAL COMPUTERS FOR THE BLIND AND VISUALLY IMPAIRED

National Braille Press
88 St. Stephen Street
Boston, MA 02215
(617) 211-6160

ADD-ONS, THE ULTIMATE GUIDE TO PERIPHERALS FOR THE BLIND COMPUTER USER

National Braille Press Inc.
88 St. Stephen Street
Boston, MA 02115
(617) 266-6160

AIDS AND APPLIANCES REVIEW

The Carroll Centre for the Blind
770 Centre Street
Newton, MA 02158
(617) 969-6200

A quarterly review of technical aids published from 1979 until Summer 1984. Though no longer published, each is rich in information, particularly on low tech items. Issues 10, 11, and 12 concentrate on computers and peripherals.

AMERICAN FOUNDATION FOR THE BLIND, INC.

15 West 16th Street
New York, NY 10011
(212) 620-2082

The National Technology Center of the Foundation has been established to provide a resource for blind and visually impaired persons, professionals in education and rehabilitation, employers, researchers, and developers and manufacturers of aids and devices. The Center has three components: National Technology Data Base; Evaluations; Research and Development.

ASSISTIVE DEVICES FOR DEAF-BLIND PERSONS

CNIB
1929 Bayview Ave.
Toronto, Ontario M4G 3E8
(416) 486-2500

A comprehensive listing of adaptive devices for deaf-blind persons regularly updated. The most comprehensive catalogue on Canadian products. Available in print or Apple/IBM disc.

CANADIAN NATIONAL INSTITUTE FOR THE BLIND

51 offices across Canada

CNIB has in place seven Regional Technical Aids Centres (Vancouver, Edmonton, Regina, Winnipeg, Toronto, Ottawa, and Hamilton) with several more opening in the next few years (e.g., Fredericton, Sudbury, Calgary, St. John's, and Halifax). Staffed by a Technical Aids Co-ordinator, these centres are designed to help blind and visually impaired persons and persons acting for them to find technological solutions to problems. Contact the Technical Aids Centre nearest you.

Other agencies which have Technical and Low-vision Aids Departments in Quebec and Ontario are:

CENTRE LOUIS-HEBERT INC.
525 Boul. Wilfred Hamel
Wing J
Quebec, Que. G1M 2S8

INSTITUT NAZARETH ET LOUIS BRAILLE
1255, Beauregard
Longueuil, Quebec J4K 2M3

MONTREAL ASSOCIATION FOR THE BLIND
7000 Sherbrooke Street West
Montreal, Quebec H4B 1R3
(514) 489-8201

SIGHT ENHANCEMENT CENTRE
University of Waterloo School of Optometry
Waterloo, Ontario, N2L 3G1

SAMUEL HARRIS BAKER FOUNDATION
Low-vision Clinic
500 University Ave.
Toronto, Ontario, M5G 1V7

VISION CANADA
167 O'Connor St., Suite 106
Ottawa, Ontario, K2P 1V3

OPTOMETRIC VISION INSTITUTE OF TORONTO
815 Danforth Ave
Toronto, Ontario, M4J 1L2

W. ROSS MACDONALD SCHOOL
350 Brant Ave.
Brantford, Ontario, N3T 3J9

CLOSING THE GAP (Computers for the Handicapped)

Closing the Gap Inc.
P.O. Box 68
Henderson, Minnesota 51044
(612) 248-3294

A bi-monthly tabloid on computer products for the handicapped. Generally, nearly 50 percent is devoted to blind and visually impaired persons. One issue each year (generally February/March) features a comprehensive listing of all software and hardware designed for access to computer by blind and visually impaired persons. Extensive advertisements of new products.

CLOSING THE GAP CONFERENCE ON MICROCOMPUTER TECHNOLOGY

Held annually in October in Minneapolis, it is probably the most comprehensive conference on and display of computer access technology for the disabled.

COMPUSERVE
P.O. Box 20212
5000 Arlington Center Blvd.
Columbus, OH 43220
(800) 848-8199

An online data base within which is a disabled users' group (NIPSIG). Online discussion group, bulletin board of hardware/ software, etc. No subscription fee for consumers, per hour charge billed monthly.

COMPUTER ACCESS FOR BLIND & VISUALLY IMPAIRED STUDENTS

C-Tec Computer Training & Education Centre
399 Sherman Ave., Suite 12
Palo Alto, CA 94306
(415) 493-5000, ext. 4378

This manual includes resource lists of training and evaluation centres, publications, and computer products for blind and visually impaired persons.

COMPUTER EQUIPMENT AND AIDS FOR THE BLIND AND VISUALLY IMPAIRED: A Resource Guide (1985)

Baruch College
City University of New York
Box 515
17 Lexington Ave.,
New York, NY 10010
(212) 725-7644

Includes review of hardware and software as well as resource information on networks, sources of information, user groups, and a glossary of computer terminology.

DISC (Disabled Information Systems of Canada)

A Canadian national computerized databank, bulletin board and electronic mail system at the University of Calgary Walter Dinsdale Centre. It includes a network of visually impaired computer users. Access via computer and modem.

INFOVISIE, 1986, TECHNICAL AIDS FOR DEAF-BLIND PERSONS

European Conference on the Education and Management of the Deaf-Blind
VZW INFOVISIE
Capucijnenvoer 7
B-3000 Leuven
Belgium

A relatively complete catalogue listing of technical aids for deaf-blind persons. Includes sections regarding aids, alarm systems, conversation aids, wireless sound transmission systems, telephones and telephone aids, orientation aids, and others.

INTERNATIONAL DIRECTORY OF TACTILE MAP COLLECTIONS

National Library Service for the Blind and Visually Impaired,
Library of Congress, 1985.

Lists and documents many collections of tactile maps around the world. Is not comprehensive as it does not list the CNIB which has a large collection.

INTERNATIONAL GUIDE TO AIDS & SERVICES FOR THE DEAF-BLIND
and
INTERNATIONAL REGISTER OF RESEARCH ON VISUAL DISABILITY
and
INTERNATIONAL SURVEY OF AIDS FOR THE PARTIALLY SIGHTED
and
INTERNATIONAL SURVEY OF AIDS FOR THE VISUALLY IMPAIRED

John M. Gill, Ph.D
Royal National Institute for the Blind
224 Great Portland Street
London W1N 6AA
England
Telephone: 01144-1-3881-16266

Resource books on computer and non-computer related equipment for blind and visually impaired persons, with greater emphasis on European technology than in other publications.

Dr. Gill is also an excellent resource person who heads up a large research unit on technology at the RNIB. Much of the research is in the area of access issues.

JOURNAL OF VISUAL IMPAIRMENT AND BLINDNESS

American Foundation for the Blind
15 West 16th Street
New York, NY 10011

A journal which is published ten times a year and includes a 2-7 page section entitled "Random Access". "Random Access" reviews the latest technology. See especially "Special Issue on Microcomputers", Vol. 78, no. 9, November 1984.

E.g., "An Evaluation of Synthetic Speech Software Programs" (February 1987) and "A Look at Five Braille Printers" (June 1987).

JOURNAL OF VISUAL REHABILITATION

Media Productions & Marketing Inc.
2440 O Street, Suite 202
Lincoln, Nebraska 68516

A new journal which occasionally will feature articles on technology, e.g., "A Guide to Large Print Computer Access," Vol. 1, no. 2, 1987.

SENSUS

Sensory Aids Foundation
399 Sherman Ave., Suite 12
Palo Alto, CA 94306
(415) 329-0430

A quarterly journal on technology for blind and visually impaired persons. It features a comprehensive comparative review of technology, e.g., one issue concentrates on large print computer access (Summer, 1987). It is designed as a "Consumer's Guide to Technology for Blind and Partially Sighted People."

SMITH-KETTLEWELL TECHNICAL FILE

Institute of Visual Sciences
2232 Webster Street
San Francisco, CA 94115
(415) 561-1620

TECHNOLOGY UPDATE

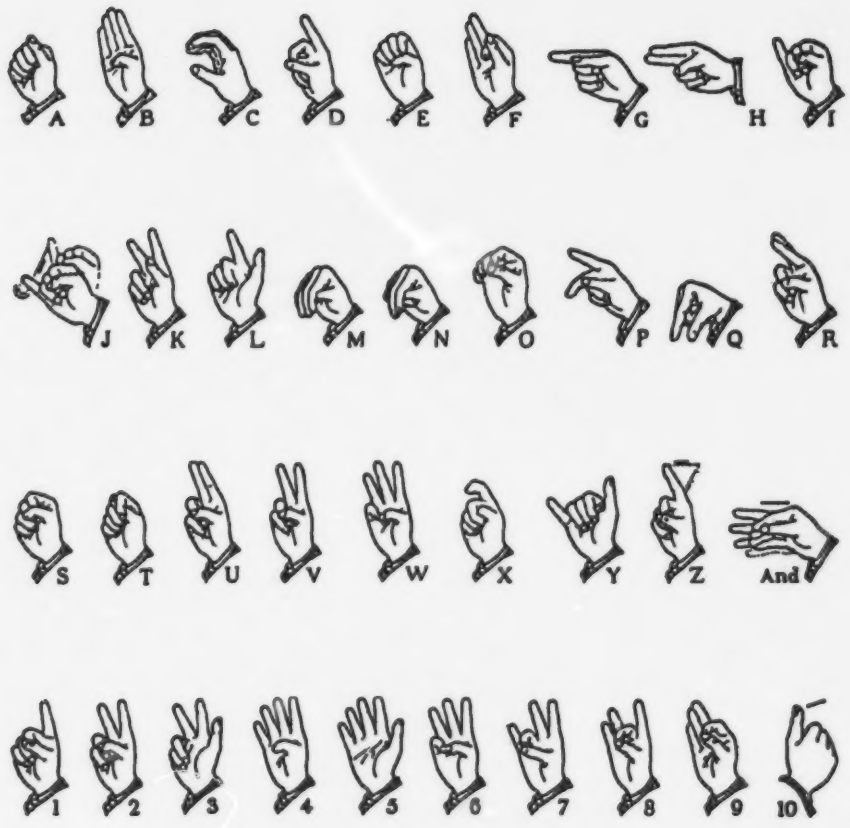
Sensory Aids Foundation
399 Sherman Ave., Suite 12
Palo Alto, CA 94306
(415) 329-0430

A monthly newsletter on technology for blind and partially sighted people. It is written in a clear style for non-technical readers. It covers new developments in the field.

MANUAL ALPHABETS FOR DEAF-BLIND PERSONS

APPENDIX

B



THE MANUAL ALPHABET

BRITISH TWO HAND MANUAL ALPHABET

STATISTICAL INFORMATION ON THE CLIENT POPULATION OF THE CNIB, 1986

APPENDIX

C

The following statistics portray only those visually impaired persons in Canada who have chosen to become registered with the CNIB.

TOTAL CNIB CLIENT POPULATION BY AGE GROUP—1986

CNIB DIVISIONS	5 yrs. & under	6-15	16-19	20-29	30-39	40-49	50-64	65-80	80 yrs. & over	Division Totals	DIV.%
Nfld./Lab.	24	93	34	94	118	132	216	294	187	1192	2.27%
N.S./P.E.I.	45	149	48	142	163	157	352	565	467	2088	3.98%
N.B.	22	90	41	121	147	137	252	433	350	1593	3.04%
Qué.	29	179	123	524	833	824	1494	2347	2542	8895	16.96%
Ont.	217	753	331	1199	1470	1181	2401	5681	7913	21146	40.33%
Man.	62	116	44	153	195	152	276	772	1121	2891	5.51%
Sask.	40	120	48	142	160	137	243	638	961	2489	4.75%
Alberta/N.W.T.	84	235	94	300	336	279	458	1071	1451	4308	8.22%
B.C./Yukon	153	283	141	359	474	372	642	2071	3339	7834	14.94%
AGE TOTALS	676	2018	904	3034	3896	3371	6334	13872	18331	52436	100.00%
AGE %	1.29%	3.85%	1.72%	5.79%	7.43%	6.43%	12.08%	26.46%	34.96%	100.00%	

NEW CNIB CLIENTS BY AGE GROUP—1986

CNIB DIVISIONS	5 yrs. & under	6-15	16-19	20-29	30-39	40-49	50-64	65-80	80 yrs. & over	Division Totals	DIV.%
Nfld./Lab.	14	23	7	11	11	14	27	31	16	154	2.26%
N.S./P.E.I.	23	13	9	16	7	14	34	60	57	233	3.42%
N.B.	12	14	5	15	11	8	25	73	58	221	3.25%
Qué.	9	18	14	25	37	30	47	111	53	344	5.06%
Ont.	72	79	31	102	81	110	276	1135	1029	2915	42.84%
Man.	28	17	7	22	24	16	43	190	193	540	7.94%
Sask.	19	18	2	14	14	12	23	119	131	352	5.17%
Alberta/N.W.T.	33	16	10	40	44	30	71	270	220	736	10.82%
B.C./Yukon	61	35	16	43	47	58	80	489	481	1310	19.25%
AGE TOTALS	271	235	101	288	276	292	626	2478	2238	6805	100.00%
AGE %	3.98%	3.45%	1.48%	4.23%	4.06%	4.29%	9.20%	36.41%	32.89%	100.00%	

MOST COMMON DIAGNOSES BY AGE GROUP OF NEW CNIB CLIENTS—1986

AGE GROUP	Macular Degeneration	Other Retinal Disorders	Cataract	Glaucoma	Diabetic Retinopathy	Disorders of Visual Pathway	Disorders of Refraction	Corneal/ Scleral Conditions	Other	TOTAL/PERCENT
5 & under	3	47	22	6	0	64	10	3	116	271/ 3.98%
6-15	8	37	22	1	1	40	22	1	103	235/ 3.45%
16-19	6	23	10	0	0	16	13	0	33	101/ 1.48%
20-29	8	66	18	4	39	29	22	10	92	288/ 4.23%
30-39	20	77	17	6	35	37	17	7	60	276/ 4.06%
40-49	19	66	13	11	34	32	23	7	87	292/ 4.29%
50-64	111	85	59	30	108	51	34	20	128	626/ 9.20%
65-80	1409	186	185	215	182	63	27	54	157	2478/36.41%
80 & over	1522	113	209	216	14	29	11	35	89	2238/32.89%
TOTAL	3106	700	555	489	413	361	179	137	865	6805/100.00%
%	45.64%	10.29%	8.16%	7.19%	6.07%	5.30%	2.63%	2.01%	12.71%	

SERVICE AND STAFF TRAINING FOR TRANSPORTATION TERMINAL PERSONNEL SERVING VISUALLY IMPAIRED TRAVELLERS

APPENDIX

D

Service and Staff Training Aspects

D1.1 Introduction

For a visually impaired traveller, a crucial element of any environment is the service expertise of personnel who work in the setting. Their attitude, training, professional expertise and personal comfort level in assisting a visually impaired person have a significant effect on the accessibility of the environment. No matter how well a terminal is designed physically, the most important accessibility feature in that terminal is the attitude of the people who work there.

This Appendix outlines specific services and assistance transportation personnel may provide for visually impaired passengers. Most of the information relates to situations within airport facilities but may be generalized to facilities for other travel modes. Two categories of staff considerations are addressed; services offered and staff training.

D1.2 Services

Transportation personnel may utilize the following information as a guide to ensure adequate service for visually impaired persons in transportation terminals and aircraft. Virtually all of the information mentioned below has been paraphrased from a handbook for airline passenger service personnel. "How to Serve Blind and Visually Impaired Passengers", American Council of the Blind, 1985.

Services are discussed under the following headings:

- Misconceptions regarding visually impaired persons.
- Introduction of transportation personnel.
- Types of assistance for ease of mobility.
- Personnel acting as sighted guides.
- Curbside assistance.
- Ticket counters.
- Seat selection.
- Proceeding through security.
- Proceeding to and through the gate.

- Canes on planes.
- Dogs on planes.
- Orientation to mode of transportation.
- Meals and beverages.
- Disembarking.
- Deaf-blind passengers.

D1.2.1 Misconceptions Regarding Visually Impaired Persons

The majority of visually impaired persons have some degree of usable vision: Less than 10 percent are totally blind. Misconceptions as to the type of service needed by visually impaired are widespread. The following text cites the most common misconceptions and provides the correct information.

- Many people believe that a visually impaired person requires constant attention and assistance when travelling. Actually most visually impaired travellers are quite independent. Many require only navigational and orientation assistance. The travelling individual is quite capable of indicating how much and what type of assistance is required. Constant attention is not required. From a service point of view, the important thing to remember is to ask the travellers if their needs are not clear to you.
- A visually impaired person with low vision may benefit greatly by utilizing various low-vision aids. Sometimes these aids are rather unusual in appearance, but to the user the benefit of the aid far outweighs the cosmetic appearance. Some low-vision persons may benefit from wearing special filtering lenses (e.g. sunglasses) indoors to eliminate glare and enhance colour/brightness contrast. Most low-vision persons, whether using a low-vision aid or not, require a very close viewing distance when reading print information. Most individuals also require a longer viewing period to focus on the material to effectively read it.
- Another misconception is that one must speak loudly to visually impaired persons. Not true. Most visually impaired people are able to hear normally and do not require people to address them in loud voices. If a hearing problem also exists, visually impaired people will make their needs known to you as effectively as a hearing-impaired. sighted person would.

- One further misconception relates to a visually impaired person's mobility. An individual may use residual vision, a cane, guide dog or sighted guide to assist mobility. The individual however does not require constant overseeing in a mobility situation. The use of the mobility-assistive device will provide the traveller with adequate information to avoid obstacles.

In most cases there is no need to pay constant attention to the visually impaired traveller, rather be prepared to respond to specific travel needs. A staff person should be comfortable in approaching the individual on an adult basis and ask what assistance may be required.

D1.2.2 Introduction of Transportation Personnel

Staff members should introduce themselves to a visually impaired traveller by verbally identifying themselves and then either saying the traveller's name (if the name is known) or touching the traveller's arm or shoulder. They should relay name, title and type of assistance that can be provided. Further, the transportation personnel may ask what types of assistance are required and verbalize the different procedures/routes which the visually impaired person may be taking while preparing for travelling or on the trip itself. Some visually impaired people have travelled extensively and may not require detailed information - others may require very detailed information.

D1.2.3 Types of Assistance for Ease of Mobility

Visually impaired individuals may use any of a myriad of devices/techniques for mobility assistance. The most ubiquitous are: a white cane, a guide dog, low-vision aid, and a sighted guide (sighted escort). Since some visually impaired people travel without any assistive device whatsoever, the staff person may ask individual travellers what assistance they may need for mobility.

D1.2.4 Types of Assistance for Ease of Orientation

In order to travel independently, visually impaired people must not only have adequate mobility skills. they must also have good orientation skills. Many visually impaired persons who are independent travellers in familiar environments require assistance in a new environment. The level of assistance necessary to orient to a new environment depends on several factors: the person, the complexity of the environment, and the availability of accessible information systems to assist orientation skills.

Staff can assist with a traveller's orientation process by asking what information or assistance the traveller may require and then providing that information in clear, concise terms. Cite landmarks that the visually impaired person can identify e.g., texture changes underfoot, sound cues and visual landmarks that the traveller might use residual sight to identify. For many visually impaired travellers who are faced with an unknown, complex environment to orientate through, and who have a very low level of usable vision, the provision of a sighted guide may be the quickest and most comfortable way to access the transportation mode.

D1.2.5 Personnel Acting as Sight Guides

When staff members act as sighted guides they should offer their arm so that the visually impaired person can follow approximately one half step behind. The visually impaired person will automatically grasp the person's arm above the elbow and follow alongside but slightly behind the sighted guide.

When a guide dog is present the staff person should offer his/her left arm. The guide dog is usually trained to travel on the left side of its master. The visually impaired person will likely drop the dog's harness (but retain the dog's leash) and use his/her right hand to clasp the staff person's arm. In other words, people guides are usually on the right and dog guides on the left of the traveller.

When guiding a visually impaired person to a chair, the sighted guide need only place the person's hand on the back of the chair in order to indicate the configuration and placement of the chair. Always pause at major elevation changes, such as curbs or stairs, and briefly explain what is ahead in the path of travel.

The staff person should never push the traveller ahead. It is not necessary to back down an aisle/passageway in front of a visually impaired person.

D1.2.6 Curbside Assistance

When personnel are assisting a visually impaired traveller from a vehicle to a doorway or ticket counter, they should identify themselves as described in D1.2.2. In this situation, the staff person's title should be clearly given so as to avoid embarrassment when tipping. The staff person should then ask what type of assistance is required.

The visually impaired person should not be left stranded in the middle of the doorway or corridor, but should be taken to the next step in the travel procedure (e.g. ticket counter). There is no need to position the traveller ahead of other passengers in a line for the ticket counter, simply lead the person to the end of the line and describe the magnitude of the line.

D1.2.7 Ticket Counter

Ticket counter staff assist with baggage check and ticket information. Staff persons should be familiar with signature guides. Often visually impaired people request the staff person to position a signature guide so that credit card receipts, tickets, etc. may be properly signed. Some travellers simply use the edge of a credit card as a guide to sign documents.

When processing baggage the ticket counter staff may review the pieces of luggage the traveller has and the corresponding tags to confirm proper tagging of all the traveller's luggage.

The baggage tags and ticket should then be provided directly to the visually impaired person (and each identified for the person). Tickets/tags should not be given to the escort because decision as to who will manage these items is made by the traveller.

When currency is exchanged for purchasing tickets the staff person should count the bills and as they are returned, indicating what denominations are being handed to the visually impaired person.

D1.2.8 Seat Selection

The visually impaired person should have the right to seat selection. Even when accompanied by a guide dog, a visually impaired person may be situated in virtually any seating accommodation available to other passengers. Guide dogs often locate themselves underneath seating.

D1.2.9 Proceeding to Security

After ticket and baggage processing are complete, staff may assist the visually impaired traveller to security. There is no need to identify the traveller with a handicap button labelling a disability nor is there need for the use of a wheelchair.

The visually impaired traveller may then be left at a waiting area adjacent to security or at a restaurant or lounge, depending upon the traveller's schedule and requests.

D1.2.10 Proceeding Through Security

After arrival at the security area, staff may assist the visually impaired person by taking carry-on baggage or guiding the person as to the proper placement of baggage for inspection.

Staff may also hold the traveller's white cane which will be returned following passage through the magnetometer. Staff should at least verbally indicate where the entrance is for proceeding through the magnetometer and the travel distance required to clear it.

When a guide dog is utilized by the visually impaired traveller, staff may take the guide dog through prior to the traveller proceeding. There is no problem in separating dog guide and master for the short distance.

Staff should then ensure the white cane, relevant baggage, keys, coins etc., are retrieved by the visually impaired passenger.

D1.2.11 Proceeding to and Through the Gate

Assistance in identifying the proper gate and relevant waiting area may be required depending upon the individual. Once the gate is located, individuals may identify themselves to the personnel at the gate and indicate a preference for preboarding assistance. Some individuals prefer not to be preboarded. Such preferences should be respected. Remember not all visually impaired individuals use a white cane or guide dog hence staff may not be able to identify them. These travellers may simply identify themselves verbally and request preboarding assistance.

Sighted guide assistance may be provided for travellers to gain access to the mode of transportation and to locate their seats.

D1.2.12 Canes on Planes

Usually folding canes are used for assistance with mobility. Some elderly, visually impaired persons, or visually impaired persons with other physical disabilities utilize support canes which are not collapsible. A suitable location for a support cane on an airplane is necessary. The cane may be stored in auxiliary storage area near the

passenger's seat or be placed flat on the floor in front of the individual's seating (depending upon airline policy). The visually impaired person must be told of the cane's location so that the individual is able to access the cane independently.

D1.2.13 Dogs on Planes

Guide dogs must be allowed in the cabin area with the visually impaired master. Most dog guides are well disciplined and trained. They use a minimum of floor space adjacent to their master's seat.

There is no need for special treatment of guide dogs on planes. In fact, personnel should avoid petting or feeding the dog without the master's consent.

D1.2.14 Orientation to Mode of Transportation

Staff should assist the passenger to the area where canes or baggage may be stored and where they may be retrieved. Staff may also review the type and style of the transportation vehicle. Experienced travellers may already have become accustomed to different types of vehicles and may only need to know the model type. Next the staff person should seat the individual and explain the distance to and location of the nearest emergency exit. The location of the nearest washroom in relation to the person's seat should also be described.

Next the staff person should indicate any controls related to head-set jacks, volume/tone controls, air vents, lights and call buttons.

Finally, emergency procedures with indication and demonstration of oxygen and life jacket should be given.

D1.2.15 Meals and Beverages

Meal trays and beverages should be presented directly to all visually impaired individuals. An explanation of what is on the tray and where the items are located is always helpful. If unsure of how to explain location of items, use the clock technique (glass at one o'clock, dessert at ten o'clock, utensils at three, etc.).

In some instances a visually impaired person may request that an entree be deboned or cut into portions for ease of eating.

Presentation of hot beverages is also a concern. Please ensure that beverages are presented directly to the person and not simply placed on the passenger's tray.

If there are charges for any of the meal/beverages, return change to the individual and indicate what denominations of bills are being presented.

D1.2.16 Disembarking

Staff should enquire if a visually impaired person requires an escort when disembarking. On occasion, a visually impaired person may wish to remain until most passengers leave and then acquire assistance to disembark. The visually impaired individual will, in most instances, leave with the other passengers.

If the person does require assistance, the individual may ask to be escorted to a washroom, telephone and/or the baggage-claim area. Finally, the individual may require assistance to a ground transportation vehicle.

D1.2.17 Deaf/Blind Passengers

Deaf/blind individuals are often taken to the terminal and met at the terminal by an escort. The escort may explain the traveller's needs and means of communication to receiving staff.

Several means of communication may be used between staff and deaf/blind people, for example:

- Large print on paper for partially sighted persons.
- Staff may use finger to print letters on the person's palm.
- The deaf/blind person may have a teletouch machine which is essentially a small typewriter with a braille cell for reception letters. The staff person need only type correspondence into the machine.

Other orientation and service for the deaf/blind traveller should be consistent with that already described for the visually impaired traveller.

D1.3 Training of Staff

Staff training is discussed under three headings:

- Consultation with the orientation and mobility instructor's local service agencies.
- Provision of services described in D1.2.
- Simulating visual impairment.

D1.3.1 Consultation with Local Service Agencies

Most agencies, such as the CNIB, require advance notification in order to assist with in-service and training needs of staff. Contact your local service agency for information as to the forms of assistance available and for answers to specific questions.

D1.3.2 Provision of Services Described in D1.2

Staff training need not be complicated nor time consuming. The basic service information given in D1.2 may serve as a guideline and should as such, be made available to all transportation service personnel. If additional information is considered necessary, it can be requested from your local service agency.

D1.3.3 Simulating Visual Impairment

Simple simulations of encounters with visually impaired travellers may be provided to staff through presentations by the local service agency. In these simulations, the staff is divided into teams of two. One team-member is blindfolded or fitted with a low-vision simulator, and the other acts as a sighted guide or staff person. The teams work through several scenarios ranging from the traveller's arrival at the terminal to actual boarding procedures. Team members then reverse their roles to complete the training situation.

WHAT EVERYONE SHOULD KNOW ABOUT GUIDE DOGS

APPENDIX

E

What Everyone Should Know About Guide Dogs

A dog is not a pet but a highly trained animal whose chief responsibility is to guide a blind person from place to place safely and independently.

Guide dogs are specially selected and trained at schools in the United States and Canada. Applications from Canadians are welcome by any of the American schools and information concerning them can be obtained from the CNIB.

When a dog is 12 to 14 months old, it begins a three-month training program at the school before being teamed up with a blind person. At this time the dog is taught to adjust to various environments, sounds and people. It also learns to recognize obstacles and situations which may be dangerous for the owner and dog. Once dog and owner become a working team, they will train at the centre for an additional month to learn about this type of mobility and about each other.

The dog is highly intelligent, but does not possess any supernatural or unusual powers. Instead, the dog reacts to specific commands given by the owner, such as "Left", "Right" or "Forward". By following these instructions the dog will guide the owner to the desired destination. The dog will also disobey a command which might place the team in a hazardous situation.

All guide dogs, regardless of their breed or school, can be recognized by the leather harness and the U-shaped handle which is held in the owner's left hand.

If the dog is wearing a harness, **do not distract or touch the dog without the owner's permission**. Such an action may be dangerous to them both.

In July 1976, a law was passed in Canada giving any blind person accompanied by a guide dog the right to enter any public place, including restaurants, snack-bars, theatres, hotels and all forms of public transportation. The guide dog has been specially trained to lie quietly under a chair or table or sit in a corner until needed.

The term 'seeing eye' dog refers to the Seeing Eye school in Morristown, New Jersey and describes only the dogs which have been trained or bred at Seeing Eye Inc. CNIB uses the generic term 'guide dog' in reference to the animal as a mobility aid for a blind person.

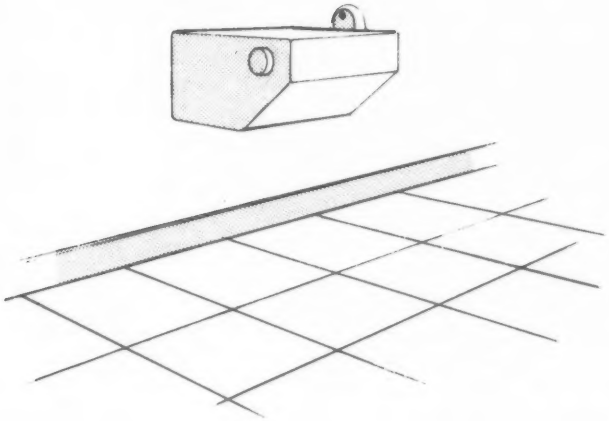
For further information contact your local CNIB office.

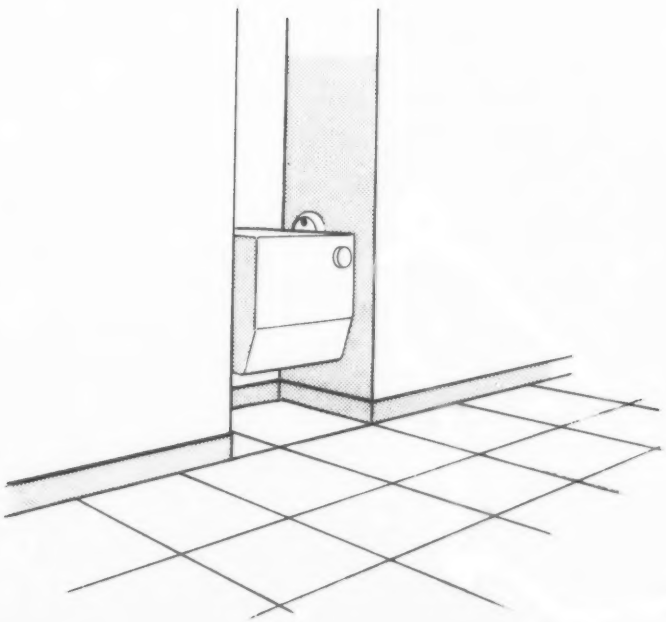
APPENDIX

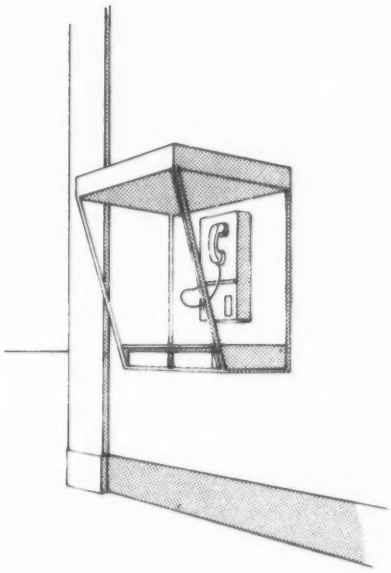
F

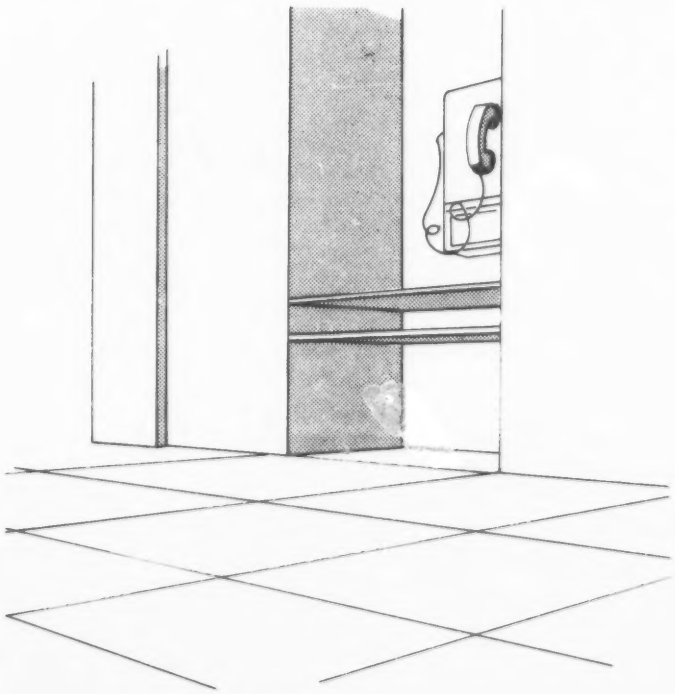
ARCHITECTURAL HAZARDS FOR VISUALLY IMPAIRED PERSONS

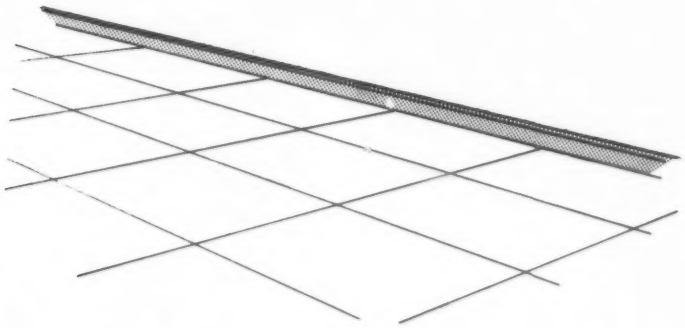
Each illustration portrays a common environmental hazard for a visually impaired person and an adaptation that frees the environment of travel hazards.

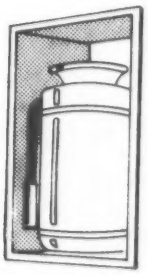


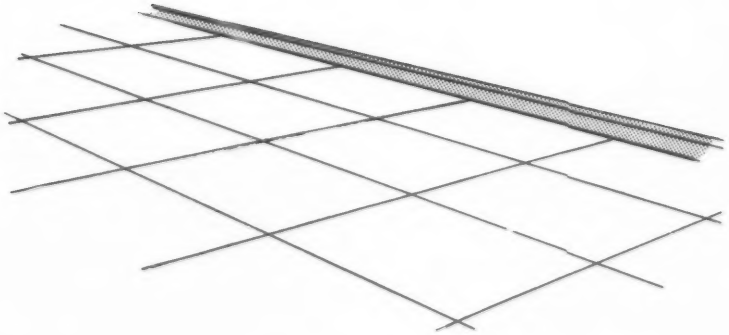


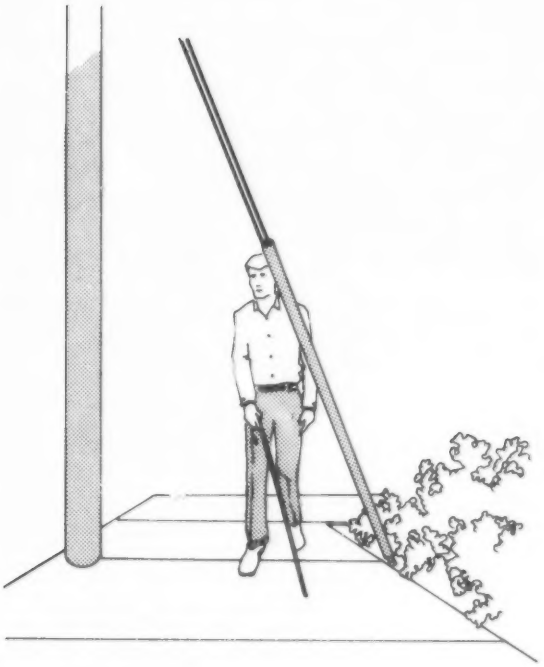


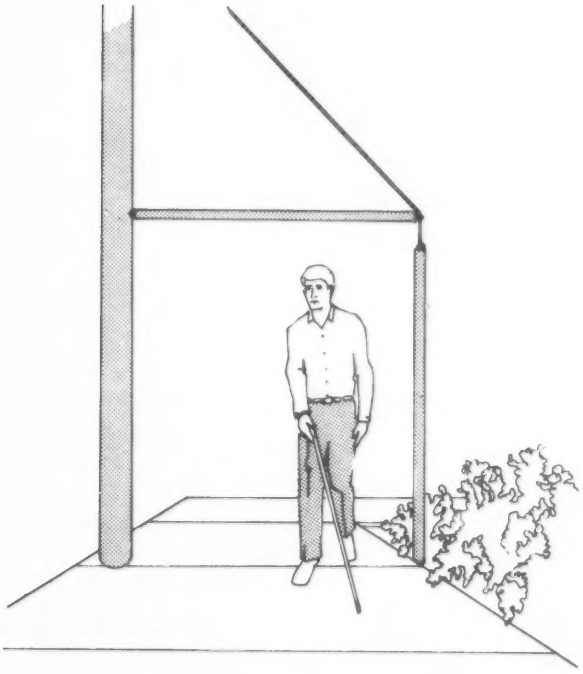


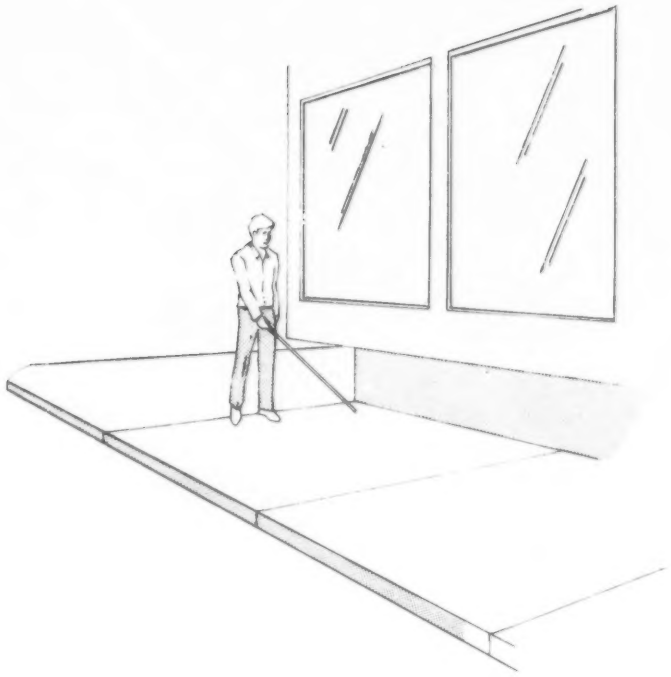


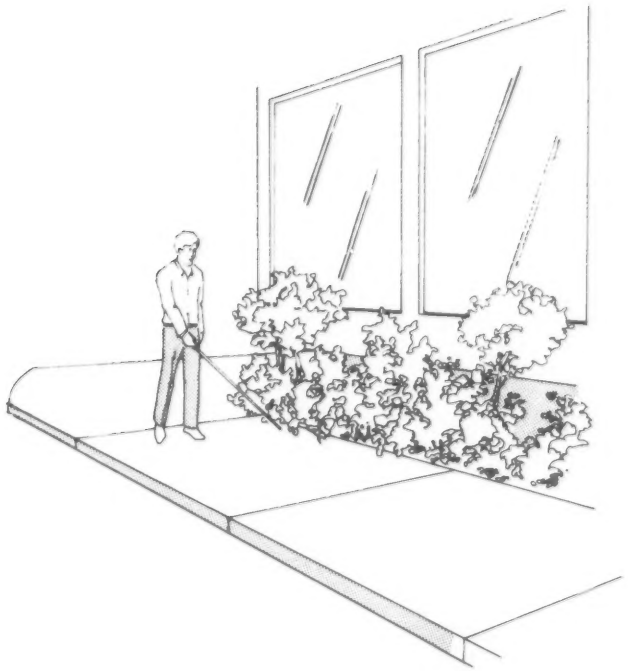


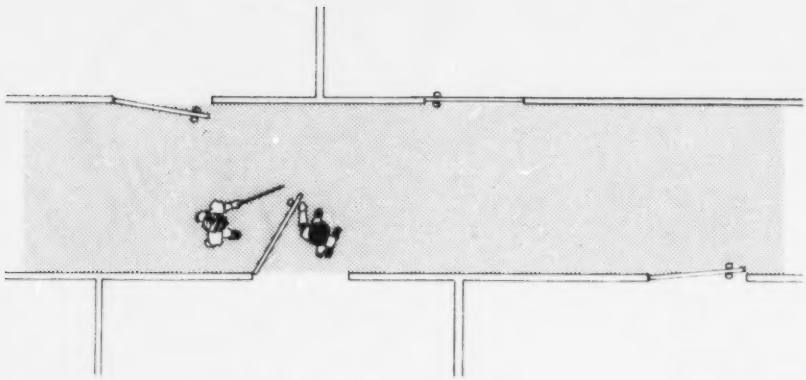


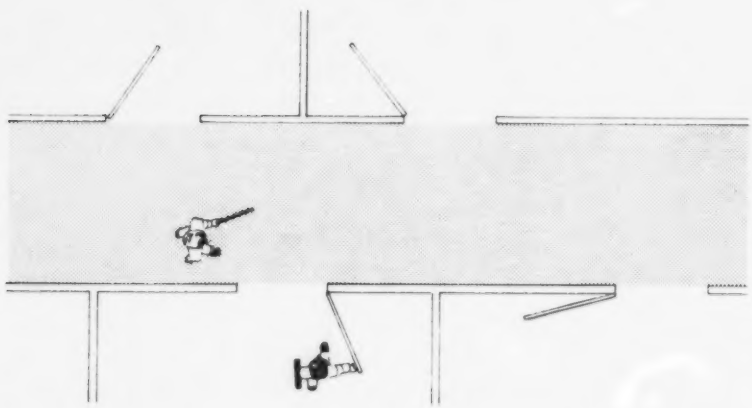


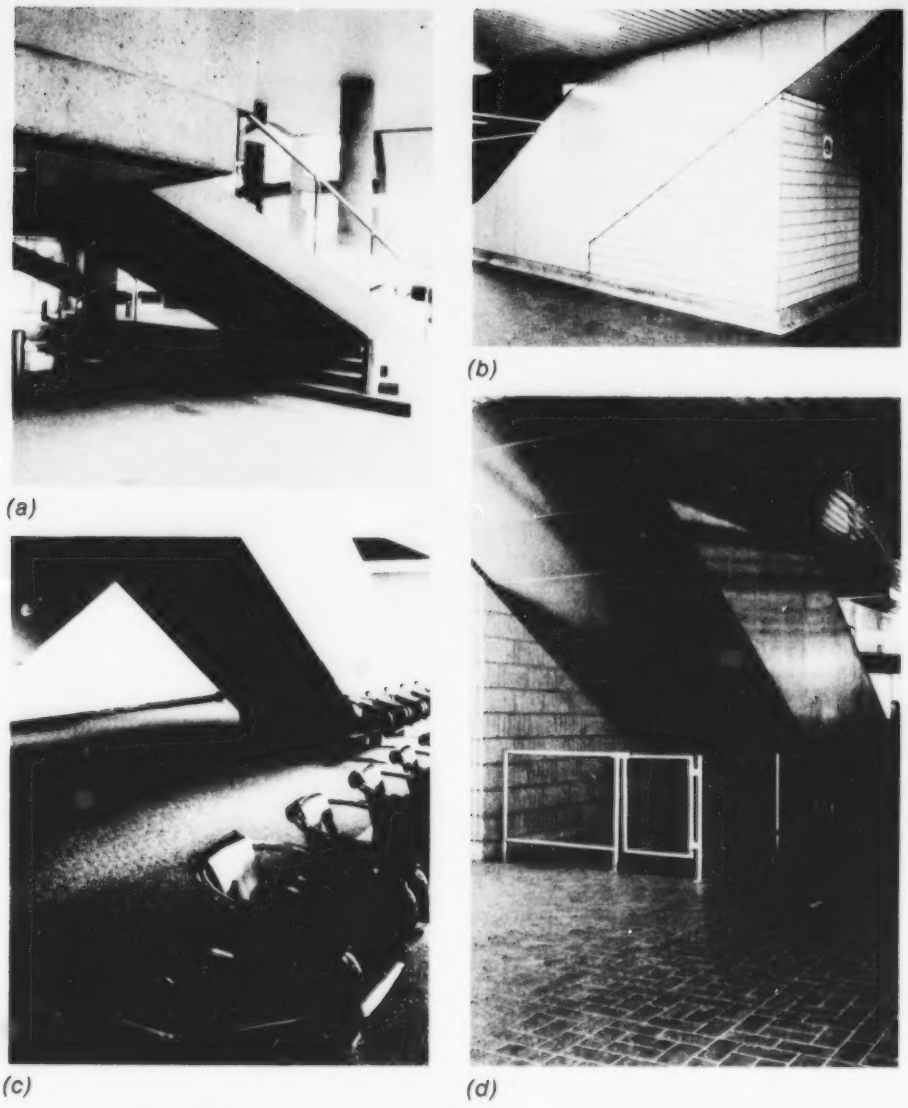












(a)

(b)

(c)

(d)

(a) and (b) illustrate open back stairways that are not cane detectable. (c) and (d) illustrate modifications that can make such areas safer travel environments for visually impaired persons. Seating arrangements, landscaping or other more esthetically pleasing adaptations rather than the gate shown in (d) can also be used to create a cane detectable barrier

By simply placing an object such as this trash can beneath the protruding ashtrays a travel hazard is eliminated from the environment. It is important that the trash can become a permanent fixed object rather than one which can be easily moved

CHARACTERISTICS OF FLUORESCENT, INCANDESCENT AND NATURAL LIGHT

APPENDIX

G

Light

G1.1 General

When one addresses the subject of illumination, three types of light sources must be considered: fluorescent, incandescent, and natural. Each of these types of light is discussed below.

G1.2 Fluorescent

Fluorescent light is widely used, especially in commercial and office settings, because: it diffuses evenly, is inexpensive, and energy efficient. It characteristically provides little contrast because it is even lighting and casts only soft shadows. Normally fluorescent lighting is harsh because it is in the blue portion of the spectrum.

The inherent flicker of this type of light presents problems for the elderly population. Commonly people with vision problems report that fluorescent lighting is very bothersome. This is especially true when the fluorescent tubes are bare with no shade or cover. People report headaches and eye strain.

The flickering is caused by the alternating current energizing the fluorescent tubes. It is possible to reduce the flicker effect by linking two fluorescent tubes so that they operate in phase opposition. Alternatively the addition of diffusers (lattice type coverings) or translucent shades around the fluorescent fixture also reduces the flicker effect. Another effective strategy is to mount the lights on a wall behind cornices which would require the light to bounce off the ceiling and walls.

G1.3 Incandescent

Incandescent light, compared to fluorescent light, is generally more directional, more easily varied, and more of a point source. Incandescent light is in the yellow portion of the spectrum. It provides heavy contrast because it casts more shadow. Incandescent lights in some fixtures, such as those which suspend an uncovered bulb overhead, can cause pinpoint glare and pools of light within relative darkness in a room or hall. An illustration of this effect is provided by older subway stations lit by incandescent bulbs suspended from the ceiling. The

traveller in that setting moves from a large, bright spot into an area of darkness. The individual also encounters pinpoint glare problems when the highly directional light is reflected off some shiny surface, e.g. tiled walls. The solutions to these problems involve the use of shades and diffusers to prevent the light from directly entering the eye.

In order to prevent visual hot-spots or glare, a number of less bright lights are better than a single bright incandescent light. Incandescent lights are particularly effective in near-work tasks. Many visually impaired persons benefit when reading by utilizing a incandescent light bulb in a lamp which can be adjusted to focus on a specific point.

G1.4 Natural Light

Sunlight is often preferred by people with vision problems because it is neither flickering nor harsh and it is bright. However, it is not easily controlled and it causes bright and dark areas which can be a problem for persons with difficulty in light adaptation.

Diffused shading can help alleviate problems due to sunlight. For patios and porches, shielding can be effected by using panels of lattice work designed for outside installation. Inside, blinds and curtains that do not cut out all the light but rather act as diffusers will help. Similarly, tinting of window glass is effective. Polarized window glass reduces glare from outside with little loss of light or change of tint, and prismatic window glass, which diffuses outside light, reduces shadows. In addition, illuminating dark areas, even during daylight hours, will provide more even lighting.

Dark, open-weave drapes can be used to effectively eliminate window glare; however, sheer drapes or white, voile translucent curtains should be avoided because they create glare due to their light-reflecting colour and transparency.

WAYFINDING SYSTEMS FOR VISUALLY IMPAIRED TRAVELLERS

APPENDIX

H

Wayfinding Systems for Visually Impaired Travellers

H1.1 Introduction

This appendix describes a wayfinding system that would be typical of accessible design both outside and inside a transportation terminal. All the attributes necessary to visually impaired travellers for orientation and mobility are present in the system discussed.

H1.2 Terminal Exterior

It is important to have an easily understood, barrier free path of travel from parking and vehicular arrival areas to the entrance doors of the terminal building. This path of travel could include many components of the exterior terminal environment, for example:

- entrances
- walkways
- islands
- curbcuts
- ramps
- stairs
- landscaping
- gratings
- parking
- traffic lights for pedestrian walkways
- construction

The above list can serve as a check list for judging the adequacy of a given wayfinding system. Each of these exterior structural components should feature adequate communication cues so that visually impaired travellers may orient themselves with ease and gain safe access to the terminal. The characteristics of the four major categories of information communication cues are briefly described below. (Refer also to Part 5 of the main body of the report).

H1.2.1 Visual Cues

Visual cues for visually impaired persons usually feature colour/brightness contrasted tones to accentuate specific areas of service. Colour/brightness contrast cues may be used in wayfinding systems for:

- Directional signs located at eye level
- Highlighting walkways tiled into a surface
- Demarcation of entrance door frames and handles.

Landmarks also may be used as visual cues. A specific landscaping feature (planting, metal structure) may be used to designate specific parking areas or entrances.

The landscaping feature to be used as a landmark should be as large and distinct as is practical. Exterior landmarks generally have to be identified from a distance to serve as a communication cue as many visually impaired people have limited distance vision and hence are able to identify only the most distinctive objects.

H1.2.2 Touch Cues

Cues directed toward a person's sense of touch are very important for communicating information to visually impaired persons. These tactile cues are usually placed on exterior walls or walkways and may be designed for sensing by either hands or feet. An identifiable wall texture adjacent to specific terminal entrances for example may be useful; however textured walkways have limited value as tactile cues. Walkway surface cues may be distorted by footware and there are also limitations on a person's ability to detect surface cues using a cane. Tactile signage also may be useful provided the signage is consistently located and the standards described in Part 6 of the main body of the report are used.

Tactile cues used for wayfinding must be separate and distinct from those used for to indicate emergency areas, stairs, elevators, escalators, etc.

H1.2.3 Audible Cues

Audition and audible cues may be used to identify strategic points in the wayfinding system. Ambient noise, produced by either vehicular or pedestrian traffic, may serve as part of the sensory cue

repertoire of a wayfinding system. Similarly the operating sounds of elevator doors, automatic entrance doors, etc., provide usable auditory cues.

Electronic devices, public address systems and talking signs also may be used as part of a well designed wayfinding system.

H1.2.4 Combination of All Three

Most visually impaired people use a combination of all three of the above communication types. An individual may therefore, proceed from arrival point past a driveway to a specific entrance by: listening for pedestrian traffic; looking for a specific landmark next to the entrance; referring to signage near the entrance; and, finally, locating the entrance door by its colour/brightness contrast to the surrounding wall and/or identifying the wall texture adjacent to the door.

Individual visually impaired travellers select different cues and have different levels of comprehension of the cues in any given wayfinding system. The wayfinding features selected by a given traveller for orientation and mobility will depend on: level of vision, the techniques used for independent travel, and the traveller's knowledge of the terminal. Therefore it is important that a piece of information be accessible from more than one cue type in the wayfinding system.

H1.3 Terminal Interior

The interior of a large, open terminal may be particularly confusing to an individual in terms of locating a certain route or destination. It is important to have easily understood, barrier free paths of travel from the entrance doors of the terminal building to the many destinations a traveller may wish to access within the terminal. The destinations could include restaurants, ticket-counters, gates, concessions etc. The paths of travel could include many components of the interior terminal environment, for example:

- entrances
- lobbies/open areas
- passageways
- emergency exits/alarm systems
- detectable warning surfaces
- building hardware furnishings
- orientation aids

- queuing/lineups
- counters
- doors
- windows
- stairs
- ramps
- escalators
- moving walkways
- elevators
- washrooms
- cafeterias/restaurants/concessions
- baggage claim area
- information access
- construction

The above list can serve as a check list for judging the adequacy of a given wayfinding system. Each of these interior structural components should feature adequate communication cues so that visually impaired travellers may orient themselves with ease and gain safe access to their chosen destinations within the terminal.

An adequate wayfinding system may be developed for each of the above building features by incorporating appropriate wayfinding cues in the design of the walls, floors and/or ceilings of each feature.

H1.3.1 Wall Design

Typically, wall design may incorporate wayfinding cues in the following manner:

- Visual cues may be incorporated through colour/brightness contrast to identify wall openings, wall fixtures and travel direction signage. Wall lighting can also assist visually impaired travellers in acquiring the orientation information needed to proceed to their destination.
- Tactual cues may be used on walls to indicate travel direction or location, specific wall finishes for certain areas for example. A stucco finish may be used to decorate all main connecting halls or baggage claim areas.
- Audible cues on walls also may be utilized. Such cues may relate to the resonant nature of the wall or the termination of a wall at intersections which then provides less sound reflectance.

- Planned combinations of visual, audible and/or tactual cues in wall design will substantially assist a visually impaired person in locating a route. All senses are usually in play to determine direction and orientation within a facility.

In any wayfinding system, wall location and design are important to the cues integral to the system. These cues assist visually impaired persons to follow a desired route or to locate a desired destination.

H1.3.2 Floor Design

Floor design incorporates many environmental features of a terminal, stairs, escalators, affixed furniture, and fountains for example. Floor finishes are varied and include tiles, interlocking ceramic brick and carpet. Careful selection of floor surfaces may be a most important element in a wayfinding system.

Both color/brightness contrast and texture of the flooring may act as valuable cues in locating routes to different service areas and in identifying the area itself. For example a differently textured flooring pathway may lead from the arrivals gate to the baggage claim area. Additionally, the colour of the textured pathway may match the colored cues and motif of the baggage claim area. The pathway itself may also feature a tiled, central strip to provide a directional cue for the totally blind individual.

Directional signage may be tiled directly into the floor pattern to denote a specific service. Some low-vision individuals may pay close attention to the immediate floor surface to avoid any stationary or mobile objects in their path of travel. Directional signage on the floor as well as on walls could assist these travellers.

H1.3.4 Ceiling Design

Ceiling design, although not as valuable to a wayfinding system as wall design, can be effectively exploited in some instances. Aspects of ideal design could include: proper and consistent siting of suspended signage; the use of acoustical tiles for large areas with echoes; and color differentiation of a very important foyer or corridor.

When suspended signage is used for wayfinding, adequate letter size, style and size of symbols should be used. (Refer to Part 6 of the main body of the report.)

H1.4 Information Counters/Directories

Information counters provide services not only for wayfinding but service schedules, fares, etc. The information counters should be strategically located for easy identification and accessibility. Each counter must be designed specifically for the role it must play in a given terminal. Closed circuit television installations should be consistently placed.

Proper signage should be used above the counter for the partially sighted and on the sides of the counter for both partially-sighted and totally-blind travellers. Signage on the side of the counter could be tactile as well as visual. An identifying floor surface adjacent to the information counter could serve as an additional location cue.

Maximum contrast and color identification could also be used for information counters. A unique colour code for all information counters could be applied throughout the terminal. Information telephones providing remote access to the counters and located throughout the terminal should use a similar colour code.

Directories should also be strategically located at a decision/reference point within the terminal. They should exist (in conjunction with information counters) at least near all the major entrances. All lettering and symbols should have good color/brightness contrast. For more specific detail on the design of directions, refer to Part 6 of the main body of the report.

H1.5 Simulation of a Wayfinding System

The following is a brief description of how a visually impaired person may use a wayfinding system to locate a desired destination. The descriptive simulations take place at an airport starting with the traveller's departure from a taxi and ending with arrival at a departure gateway.

First Simulation: Wayfinding for a low-vision person (Ms A.)

Ms A. arrives at the departures level of an airport in a taxi. She scans with her low-vision aid (monocular) and detects a large sign depicting a symbol used on her airline ticket. (She cannot read the name of the airline.) She then proceeds to the correct entrance. She also confirms the appropriate entrance by noting a large dark object which

she realizes is a planter with low shrubbery adjacent to the left of the entrance. (She has travelled on the airline once before and she recalls and recognizes the landscaping.)

She then notices an arrow on the sidewalk immediately prior to the automatic door pointing in her direction of travel. Once inside the terminal Ms A. wishes to determine which counter to proceed to for passengers with tickets. She again picks up her monocular and scans toward the direction of pedestrian flow. Fortunately the signage is not stylized and she locates it above the crowd.

Following check-in, Ms A. proceeds to the appropriate security and gate areas. She follows the light-coloured, tactile flooring past a long dark wall; past boutiques on the left; and, thus, locates security at the end of the corridor (signage indicates the correct range of gate numbers and security).

Ms A. pauses to assess where the magnetometer is situated in relation to the security counter. She hands her luggage to the security person, empties her pockets of metal objects, and proceeds through the magnetometer.

Color/brightness contrasted coding continues for signage, hallways and flooring. Ms A. is able to determine which direction to proceed by reviewing the large gate number signage placed at eye level along the walls and entryways leading to the gate waiting areas.

Ms A. finally proceeds to a check-in counter adjacent to the gate doorway, identifies herself and locates preboarding seating (dark red seats against a white wall) close to the gateway.

In this simulation Ms A., a low-vision person, has been able to use many visual cues with good contrast, as well as tactile cues on occasion, to reinforce the visual information.

Second Simulation: Wayfinding for a totally-blind person (Mr. B.)

Mr. B. is taking the same airplane. He arrives at the same entrance in a cab. The cab driver has indicated that he has stopped approximately three meters prior to the appropriate airline entrance. Mr. B. departs and listens for pedestrian traffic noise and the sound of the automatic doors. He has travelled the airline before and recalls detecting the planter to the left of the entrance. Similarly he recalls the entrance door and proceeds through it.

After entering the terminal, Mr. B. pauses and listens for sound cues indicating the presence of the check-in counter (luggage belt moving, ticket stubs being torn, voices of service personnel). He recalls from previous travel that the check-in counter is located slightly to the right of the entrance. He then locates a carpet surface which borders the main circulation route tiled surface and, shorelining with his cane, follows this carpet/tile border up to the area for the check-in counter. After locating the different textured flooring adjacent to the check-in counter, he enquires about obtaining a boarding pass and requests the gate information printed on the pass.

At this point Mr. B. is offered sighted guide assistance, but he refuses as he is familiar enough with the layout of this small terminal that he is comfortable travelling independently to the boarding area. Mr. B. then proceeds down the identical tactile pathway, past a long wall on the left and recognizes sounds from the boutiques area.

Mr. B. locates security at the end of the corridor and acquires assistance to pass through the security area and to locate the appropriate gateway waiting area. The airline personnel at the check-in counter confirm he has located the correct gateway and indicate the preboarding seating area to Mr. B.

This simulation may be an extreme example — many totally-blind individuals travel with an escort or request assistance to locate a gate. Others however, wish to use their own resources to locate the relevant departure area. Note how Mr. B. used past familiarization with his travel area — tactile, audible and directional cues — and clear directions and information from service personnel to locate his destination.

Well designed buildings eliminate the need for an excess of confusing signage. These buildings, utilizing solid wayfinding principles in their design, suggest the flow for main circulation routes and offer built-in and accessible architectural design features to assist with problem solving. This assistance is of benefit to all travellers, both visually impaired and normally sighted.

CLEARANCE DIMENSIONS

APPENDIX

I

Excerpts from the British Columbia Section 3.7 Handbook (1984) outlining cane clearance dimensions.

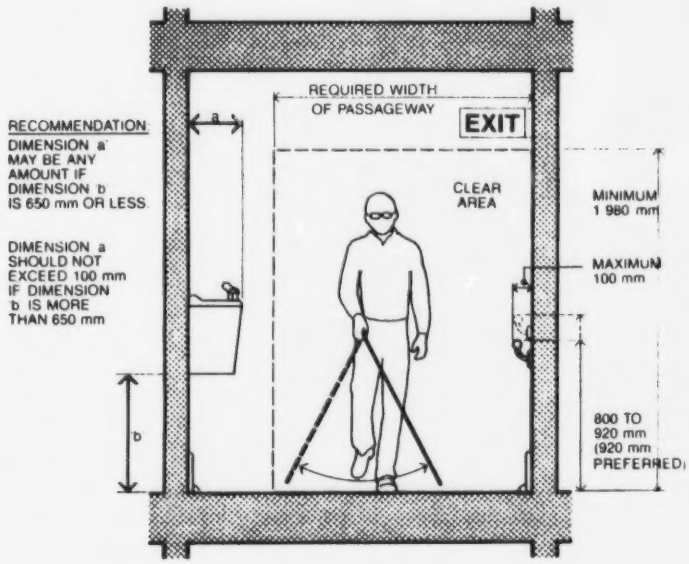

RECOMMENDATION:
DIMENSION 'a' MAY BE ANY AMOUNT IF DIMENSION 'b' IS 650 mm OR LESS.
DIMENSION 'a' SHOULD NOT EXCEED 100 mm IF DIMENSION 'b' IS MORE THAN 650 mm
REQUIRED WIDTH OF PASSAGEWAY
EXIT
CLEAR AREA
MINIMUM 1 980 mm
MAXIMUM 100 mm
800 TO 920 mm (920 mm PREFERRED)
a
b

FIGURE 3.7.13.—Interior Passageway

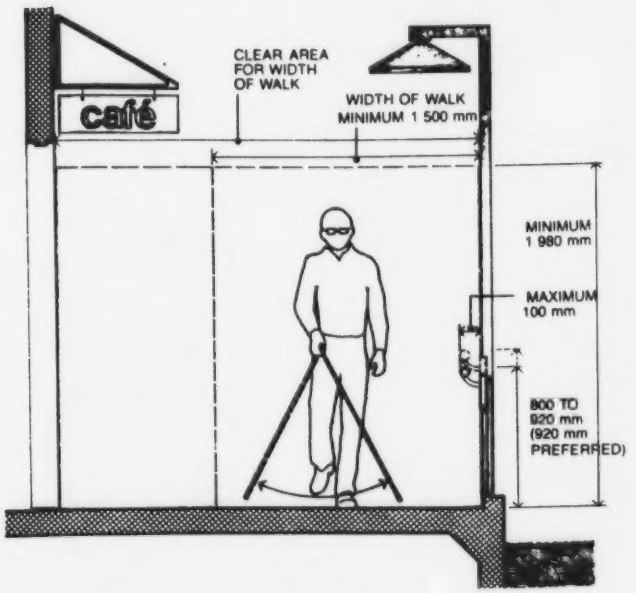
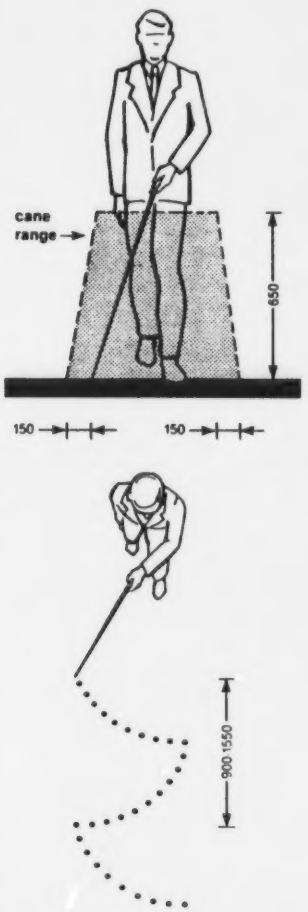

café
CLEAR AREA FOR WIDTH OF WALK
WIDTH OF WALK MINIMUM 1 500 mm
MINIMUM 1 980 mm
MAXIMUM 100 mm
800 TO 920 mm (920 mm PREFERRED)

FIGURE 3.7.7. — Exterior Paths Of Travel

Excerpts from Barrier Free Design: Access to and use of buildings by physically disabled people, 1985.

Cane use by people with visual impairments

Any object that projects more than 100 mm into an area where people circulate (i.e., corridors, washrooms, work areas) must have the surface or edge that projects the most mounted at or below 650 mm above the finished floor. This height is sufficiently detectable by a visually impaired person using a cane so as to prevent collisions and injury.



SAN FRANCISCO BAY AREA RAPID TRANSIT DISTRICT SPECIFICATION FOR ELEVATED PLATFORM DETECTABLE WARNING SURFACE TILE

APPENDIX

J

Excerpts from report:

Bay Area Rapid Transit District Platform
Edge Detection System Prototype Installation
and Materials Evaluation

San Francisco Bay Area Rapid Transit District
Specification for Platform Edge Detection Tile
October 18, 1985

I. SCOPE

The scope of this specification covers requirements which guarantee the essential doctrine of commonality and consistency of the Platform Edge Detection Tile for the blind and the visually impaired pedestrian.

Form

The Platform Edge Detection Tile is in the form of self-adhering synthetic rubber tiles with a distinct pattern embossed on their surfaces.

Function

The function of the tile is to provide warning or direction by being detectable under foot, and provide a noticeably different sound when struck with the long cane, resulting in an audible input.

Tile consists of flat surface with tapered edges and with 41 raised truncated cones.

II. GENERAL REQUIREMENTS

A. Material

The material shall be a synthetic rubber composition with the appropriate physical properties of resilience and high coefficient of friction.

The material must also possess resistance to wear, weather, ozone, ultraviolet, and temperature to assure long life and durability in the proposed environment. The material must meet the following minimum standards.

B. Mechanical Properties

Specific Gravity	0.97 - 0.99
Tensile Strength (ASTM D412)	1100 psi
Ultimate Elongation (ASTM D412)	350 - 400%
Hardness (Shore A)	70 - 75

C. Physical Properties

1. The abrasion resistance as measured by the Tabar Test (ASTM D3389) shows less than 0.63 grams wt. loss.

2. The ozone resistance as measured by ASTM D518 shall exhibit no cracking after 70 hours at 50 pphm ozone concentration.

3. The weather resistance as measured by exposure for 1000 hours shall exhibit little or no discoloration and less than 10% loss of tensile properties.

4. The temperature resistance as measured by ASTM. D-746 shall exhibit a brittleness point of (minus) –55 degrees F and long-term heat stability above 250 degrees F.

D. Dimensions

Width (mm)	300 mm
Length (mm)	300 mm
* Contour	DOT
* Overall Thickness (mm)	6.77 mm
* Edge Thickness (mm)	1.00 mm

E. Surface Texture

Surface finish shall be a minimum of 60 rms and a maximum of 80 rms to increase coefficient of friction in wet and dry conditions.

F. Color

1. Yellow — Must conform to Federal Color No. 33538, as shown in Table V of Standard No. 595A.

2. Black — No. 37038.

III. ADHESIVE

The tile shall be supplied with a factory applied pliant polymer adhesive with release paper. The adhesive must retain its back and adhesive qualities from -50 degrees F to +140 degrees F and it shall meet the following requirements:

THICKNESS (Nominal)	0.032 inches
HARDNESS (Shore A)	5 - 15
SOLIDS	99%
ASH	40%
ELONGATION (77 Degrees F)	500%
FORCE TO COMPRESS (ASTM C972)	80 - 165 lbs.
FLOW (ASTM C639) (190 degrees F)	0.020 (2 hrs.)
YIELD STRENGTH (ASTM C908) (77 degrees F)	6 psi

IV. QUALITY CONTROL AND CERTIFICATION OF COMPLIANCE

To guarantee the essential doctrine of commonality and consistency of geometry and performance, each shipment of tile must be accompanied by a packing slip and certification of compliance to this specification. The certification must also include the certified test results of the material used in the tile and adhesive as follows:

Tile	Adhesive
Date of manufacture	Date of manufacture
Lot number	Lot number
Specific gravity	Solids
Tensile gravity	Yield strength
Elongation	Elongation
Hardness	Hardness

V. PACKAGING

The tiles shall be packaged in boxes of 20 tiles each. Each box shall be clearly marked with the product number and type, color, lot number, and date of manufacture. Each box must contain detailed installation instructions and procedures.